

# PROJECT MANUAL

*Replace HVAC System*

*Troop G Headquarters Building -  
Missouri State Highway Patrol*

*Willow Springs, Missouri*

Designed By: McClure Engineering  
1000 Clark Ave.

St. Louis, MO 63102

Date Issued: January 25, 2024

Project No.: R2313-01

STATE of MISSOURI

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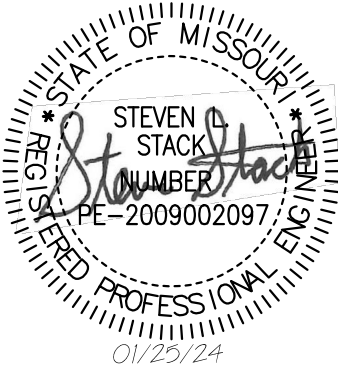
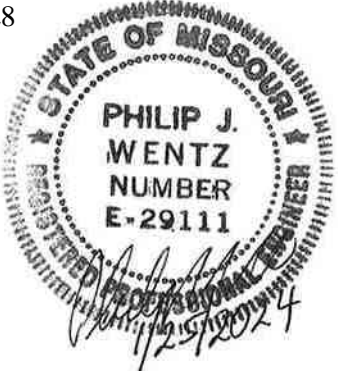
OFFICE of ADMINISTRATION  
Facilities Management, Design & Construction

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**SECTION 000107 - PROFESSIONAL SEALS AND CERTIFICATIONS**

**PROJECT NUMBER:** R2313-01

**THE FOLLOWING DESIGN PROFESSIONALS HAVE SIGNED AND SEALED THE ORIGINAL PLANS AND SPECIFICATIONS FOR THIS PROJECT, WHICH ARE ON FILE WITH THE DIVISION OF FACILITIES MANAGEMENT, DESIGN AND CONSTRUCTION:**

<p><b>STRUCTURAL:</b> Archer-Elgin Surveying and Engineering 310 E. 6<sup>th</sup> St. Rolla, MO 65401 T (573) 364-6362 F (573) 364-4782</p>  <p><b>Steven L. Stack</b> <b>MO PE-2009002097</b></p>	<p>I hereby certify that Drawings: <u>S1-S2</u> have been prepared by me, or under my supervision. I further certify that to the best of my knowledge these drawing and/or specifications are as required by and in compliance with building codes of the State of Missouri Office of Administration</p> <p>Signature <u>Steve Stack</u></p>
<p><b>MECHANICAL:</b> McClure Engineering 1000 Clark Ave. St. Louis, MO 63102 T (314) 645-6232 F (314) 645-4128</p>  <p><b>Phil J. Wentz</b> <b>E-29111</b></p>	<p>I hereby certify that Drawings: <u>M1.0 – M6.0</u> and Specifications <u>Division 23</u> have been prepared by me, or under my supervision. I further certify that to the best of my knowledge these drawing and/or specifications are as required by and in compliance with building codes of the State of Missouri Office of Administration</p> <p>Signature <u>Philip Wentz</u></p>

**ELECTRICAL:**

McClure Engineering  
1000 Clark Ave.  
St. Louis, MO 63102  
T (314) 645-6232  
F (314) 645-4128



Phil J. Wentz  
E-29111

I hereby certify that Drawings: E1.0 – E6.0 and Specifications Division 26 have been prepared by me, or under my supervision. I further certify that to the best of my knowledge these drawing and/or specifications are as required by and in compliance with building codes of the State of Missouri Office of Administration

Signature \_\_\_\_\_

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## SECTION 000115 – LIST OF DRAWINGS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract including General and Supplementary Conditions, Bid Form, and other Division 1 Specification Sections apply to this Section.

#### 1.2 SUMMARY

- A. This Section provides a comprehensive list of the drawings that comprise the Bid Documents for this project.

### PART 2 - PRODUCTS (NOT APPLICABLE)

### PART 3 - EXECUTION

#### 3.1 LIST OF DRAWINGS

- A. The following list of drawings is a part of the Bid Documents:

	<u>TITLE</u>	<u>SHEET #</u>	<u>DATE</u>	<u>CAD #</u>
1.	Cover Sheet	CS-1	1/25/24	CS-1
2.	Mechanical Symbols, Abbreviations & Details	M1.0	1/25/24	M1.0
3.	Ground Floor Mechanical Demolition Plan	DM3.0	1/25/24	DM3.0
4.	First Floor Mechanical Demolition Plan	DM3.1	1/25/24	DM3.1
5.	Roof Mechanical Demolition Plan	DM3.2	1/25/24	DM3.2
6.	Ground Floor Mechanical New Work Plan	M3.0	1/25/24	M3.0
7.	First Floor Mechanical New Work Plan	M3.1	1/25/24	M3.1
8.	Roof Mechanical New Work Plan	M3.2	1/25/24	M3.2
9.	RTU-1 Air Flow Diagram	M5.0	1/25/24	M5.0
10.	RTU-2 Air Flow Diagram	M5.1	1/25/24	M5.1
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13.	Mechanical Schedules	M6.0	1/25/24	M6.0
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15.	Ground Floor Electrical Demolition Plan	DE3.0	1/25/24	DE3.0
16.	First Floor Electrical Demolition Plan	DE3.1	1/25/24	DE3.1
17.	Roof Electrical Demolition Plan	DE3.2	1/25/24	DE3.2
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19.	First Floor Electrical New Work Plan	E3.1	1/25/24	E3.1
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22.	Electrical Schedules	E6.1	1/25/24	E6.1
23.	Structural Details	S1	1/25/24	S1
24.	Roof Framing Details	S2	1/25/24	S2

**END OF SECTION 000115**

## SECTION 001116 - INVITATION FOR BID

### 1.0 OWNER:

- A. The State of Missouri  
Office of Administration,  
Division of Facilities Management, Design and Construction  
Jefferson City, Missouri

### 2.0 PROJECT TITLE AND NUMBER:

- A. Replace HVAC System  
Troop G Headquarters Building - Missouri State Highway Patrol  
Willow Springs, Missouri  
**Project No.: R2313-01**

### 3.0 BIDS WILL BE RECEIVED:

- A. Until: 1:30 PM, April 4, 2024
- B. **Only electronic bids on MissouriBUYS shall be accepted: <https://missouribuys.mo.gov>. Bidder must be registered to bid.**

### 4.0 DESCRIPTION:

- A. Scope: The project includes the complete demolition and replacement of (2) existing HVAC units with (3) new roof mounted units, installation of VAV boxes with electric reheat in existing multizone duct, and air devices. Additional scope includes supporting structural and electrical work.
- B. MBE/WBE/SDVE Goals: MBE 10%, WBE 10%, and SDVE 3%. **NOTE: Only MBE/WBE firms certified by the State of Missouri Office of Equal Opportunity as of the date of bid opening, or SDVE(s) meeting the requirements of Section 34.074, RSMo and 1 CSR 30-5.010, can be used to satisfy the MBE/WBE/SDVE participation goals for this project.**
- C. **\*\*NOTE:** Bidders are provided new Good Faith Effort (GFE) forms on MissouriBUYS.

### 5.0 PRE-BID MEETING:

- A. Place/Time: 11:00 AM, March 21, 2024, at MSHP Troop G Headquarters Building, 1226 W. Business US-60/63, Willow Springs, MO 65793
- B. Access to State of Missouri property requires presentation of a photo ID by all persons.

### 6.0 HOW TO GET PLANS & SPECIFICATIONS:

- A. View Only Electronic bid sets are available at no cost or paper bid sets for a deposit of \$100.00 from American Document Solutions (ADS). MAKE CHECKS PAYABLE TO: American Document Solutions. Mail to: American Document Solutions, 1400 Forum Blvd., Suite 7A, Columbia, Missouri 65203. Phone 573-446-7768, Fax 573-355-5433, <https://www.adsplanroom.net>. NOTE: Prime contractors will be allowed a maximum of two bid sets at the deposit rate shown above. Other requesters will be allowed only one bid set at this rate. Additional bid sets or parts thereof may be obtained by any bidder at the cost of printing and shipping by request to American Document Solutions at the address shown above. **Bidder must secure at least one bid set to become a planholder.**
- B. **Refunds: Return plans and specifications in unmarked condition within 15 working days of bid opening to American Document Solutions, 1400 Forum Blvd., Suite 7A, Columbia, Missouri 65203. Phone 573-446-7768, Fax 573-355-5433. Deposits for plans not returned within 15 working days shall be forfeited.**
- C. Information for upcoming bids, including downloadable plans, specifications, Invitation for Bid, bid tabulation, award, addenda, and access to the ADS planholders list, is available on the Division of Facilities Management, Design and Construction's web site: <https://oa.mo.gov/facilities/bid-opportunities/bid-listing-electronic-plans>.

### 7.0 POINT OF CONTACT:

- A. Designer: McClure Engineering, Eric Poettker, 314-645-6232, email: [EPoettker@mcclureeng.com](mailto:EPoettker@mcclureeng.com)
- B. Project Manager: Christopher Lloyd, 573-526-0160, email: [Christopher.Lloyd@oa.mo.gov](mailto:Christopher.Lloyd@oa.mo.gov)

### 8.0 GENERAL INFORMATION:

- A. The State reserves the right to reject any and all bids and to waive all informalities in bids. No bid may be withdrawn for a period of 20 working days subsequent to the specified bid opening time. The contractor shall pay not less than the prevailing hourly rate of wages for work of a similar character in the locality in which the work is performed, as determined by the Missouri Department of Labor and Industrial Relations and as set out in the detailed plans and specifications.
- B. Bid results will be available at <https://oa.mo.gov/facilities/bid-opportunities/bid-listing-electronic-plans> after it is verified that at least one bid is awardable and affordable.



## Very Important MissouriBUYS Instructions to Help Submit a Bid Correctly

- A. The bidder shall submit his or her bid and all supporting documentation on MissouriBUYS eProcurement System. No hard copy bids shall be accepted. Go to <https://missouribuys.mo.gov> and register. The bidder must register and complete a profile fully with all required documents submitted prior to submitting a bid.
- B. Once registered, log in.
1. Under "Solicitation" select "View Current Solicitations."
  2. Under "Filter by Agency" select "OA-FMDC-Contracts Chapter 8", then click "Filter Solicitation" button.
  3. Select "Active Solicitations" tab.
  4. To see the Solicitation Summary, click on the Project Number and the summary will open. Click each heading to open detailed information.
- C. Here are simplified instructions for uploading the bid to MissouriBUYS:
1. Find the solicitation by completing Steps 1 through 4 above.
  2. Select the three dots under "Actions." Select "Add New Response."
  3. When the Quote box opens, give the response a title and select "OK."
  4. The detailed solicitation will open. Select "Check All" for the Original Solicitation Documents, open each document, and select "Accept." If this step is not completed, a bid cannot be uploaded. Scroll to the bottom of the page and select "Add Attachments." If you do not see this command, not all documents have been opened and accepted.
  5. The Supplier Attachments box will open. Select "Add Attachment" again.
  6. The Upload Documents box will open. Read the instructions for uploading. Disregard the "Confidential" check box.
  7. Browse and attach up to 5 files at a time. Scroll to bottom of box and select "Upload." The Supplier Attachments box will open. Repeat Steps 5 through 7 if more than 5 files are to be uploaded.
  8. When the Supplier Attachments box opens again and uploading is complete, select "Done." A message should appear that the upload is successful. If it does not, go to the Bidder Response tab and select "Submit."
  9. The detailed solicitation will open. At the bottom select "Close."
- D. Any time a bidder wants to modify the bid, he or she will have to submit a new one. FMDC will open the last response the bidder submits. The bidder may revise and submit the bid up to the close of the solicitation (bid date and time). Be sure to allow for uploading time so that the bid is successfully uploaded prior to the 1:30 PM deadline; we can only accept the bid if it is uploaded before the deadline.
- E. If you want to verify that you are uploading documents correctly, please contact Paul Girouard: 573-751-4797, [paul.girouard@oa.mo.gov](mailto:paul.girouard@oa.mo.gov) ; April Howser: 573-751-0053, [April.Howser@oa.mo.gov](mailto:April.Howser@oa.mo.gov) ; or Mandy Roberson: 573-522-0074, [Mandy.Roberson@oa.mo.gov](mailto:Mandy.Roberson@oa.mo.gov).
- F. If you are experiencing login issues, please contact Web Procure Support (Proactis) at 866-889-8533 anytime from 7:00 AM to 7:00 PM Central Time, Monday through Friday. If you try using a userid or password several times that is incorrect, the system will lock you out. Web Procure Support is the only option to unlock you! If you forget your userid or password, Web Procure Support will provide a temporary userid or password. Also, if it has been a while since your last successful login and you receive an "inactive" message, contact Web Procure (Proactis). If you are having a registration issue, you may contact Cathy Holliday at 573-751-3491 or by email: [cathy.holliday@oa.mo.gov](mailto:cathy.holliday@oa.mo.gov).

## IMPORTANT REMINDER REGARDING REQUIREMENT FOR OEO CERTIFICATION

A. SECTION 002113 – INSTRUCTIONS TO  
BIDDERS: Article 15.0, Section D1:

**As of July 1, 2020**, all MBE, WBE, and MBE/WBE contractors, subcontractors, and suppliers must be certified by the State of Missouri, Office of Equal Opportunity. No certifications from other Missouri certifying agencies will be accepted.

## **SECTION 002113 – INSTRUCTIONS TO BIDDERS**

### **1.0 - SPECIAL NOTICE TO BIDDERS**

- A. If awarded a contract, the Bidder's employees, and the employees of all subcontractors, who perform the work on the project must adhere to requirements in Section 013513 – Site Security and Health Requirements as applicable per Agency.
- B. The Bidder's prices shall include all city, state, and federal sales, excise, and similar taxes that may lawfully be assessed in connection with the performance of work, and the purchased of materials to be incorporated in the work. THIS PROJECT IS NOT TAX EXEMPT.

### **2.0 - BID DOCUMENTS**

- A. The number of sets obtainable by any one (1) party may be limited in accordance with available supply.
- B. For the convenience of contractors, sub-contractors and suppliers, copies of construction documents are on file at the office of the Director, Division of Facilities Management, Design and Construction and on the Division's web site - <https://oa.mo.gov/facilities/bid-opportunities/bid-listing-electronic-plans>.

### **3.0 - BIDDERS' OBLIGATIONS**

- A. Bidders must carefully examine the entire site of the work and shall make all reasonable and necessary investigations to inform themselves thoroughly as to the facilities available as well as to all the difficulties involved in the completion of all work in accordance with the specifications and the plans. Bidders are also required to examine all maps, plans and data mentioned in the specifications. No plea of ignorance concerning observable existing conditions or difficulties that may be encountered in the execution of the work under this contract will be accepted as an excuse for any failure or omission on the part of the contractor to fulfill in every detail all of the requirements of the contract, nor accepted as a basis for any claims for extra compensation.
- B. Under no circumstances will contractors give their plans and specifications to another contractor. Any bid received from a contractor whose name does not appear on the list of plan holders may be subject to rejection.

### **4.0 - INTERPRETATIONS**

- A. No bidder shall be entitled to rely on oral interpretations as to the meaning of the plans and specifications or the acceptability of alternate products, materials, form or type of construction. Every request for interpretation shall be made in writing and submitted with all supporting documents not less than five (5) working days before opening of bids. Every interpretation made to a bidder will be in the form of an addendum and will be sent as promptly as is practicable to all persons to whom plans and specifications have been issued. All such addenda shall become part of the contract documents.
- B. Approval for an "acceptable substitution" issued in the form of an addendum as per Paragraph 4A above, and as per Article 3.1 of the General Conditions; ACCEPTABLE SUBSTITUTIONS shall constitute approval for use in the project of the product.
- C. An "acceptable substitution" requested after the award of bid shall be approved if proven to the satisfaction of the Owner and the Designer as per Article 3.1, that the product is acceptable in design, strength, durability, usefulness, and convenience for the purpose intended. Approval of the substitution after award is at the sole discretion of the Owner.
- D. A request for "Acceptable Substitutions" shall be made on the Section 006325 Substitution Request Form. The request shall be sent directly to the project Designer. A copy of said request should also be mailed to the Owner, Division of Facilities Management, Design and Construction, Post Office Box 809, Jefferson City, Missouri 65102.

## **5.0 - BIDS AND BIDDING PROCEDURE**

- A. Bidders shall submit all submission forms and accompanying documents listed in SECTION 004113 – BID FORM, Article 5.0, ATTACHMENTS TO BID by the stated time or their bid will be rejected for being non-responsive.

Depending on the specific project requirements, **the following is a GENERIC list** of all possible bid forms that may be due with bid submittals and times when they may be due. Please check for specific project requirements on the proposal form (Section 004113). ***Not all of the following bid forms may be required to be submitted.***

### **Bid Submittal – due before stated date and time of bid opening (see IFB):**

004113	Bid Form (all pages are always required)
004322	Unit Prices Form
004336	Proposed Subcontractors Form
004337	MBE/WBE/SDVE Compliance Evaluation Form
004338	MBE/WBE/SDVE Eligibility Determination for Joint Ventures
004339	MBE/WBE/SDVE GFE Determination
004340	SDVE Business Form
004541	Affidavit of Work Authorization
004545	Anti-Discrimination Against Israel Act Certification form

- B. All bids shall be submitted without additional terms and conditions, modification or reservation on the bid forms with each space properly filled. Bids not on these forms will be rejected.
- C. All bids shall be accompanied by a bid bond executed by the bidder and a duly authorized surety company, certified check, cashier's check or bank draft made payable to the Division of Facilities Management, Design and Construction, State of Missouri, in the amount indicated on the bid form, Section 004113. Failure of the contractor to submit the full amount required shall be sufficient cause to reject his bid. The bidder agrees that the proceeds of the check, draft or bond shall become the property of the State of Missouri, if for any reason the bidder withdraws his bid after closing, or if on notification of award refuses or is unable to execute tendered contract, provide an acceptable performance and payment bond, provide evidence of required insurance coverage and/or provide required copies of affirmative action plans within ten (10) working days after such tender.
- D. The check or draft submitted by the successful bidder will be returned after the receipt of an acceptable performance and payment bond and execution of the formal contract. Checks or drafts of all other bidders will be returned within a reasonable time after it is determined that the bid represented by same will receive no further consideration by the State of Missouri. Bid bonds will only be returned upon request.

## **6.0 - SIGNING OF BIDS**

- A. A bid from an individual shall be signed as noted on the Bid Form.
- B. A bid from a partnership or joint venture shall require only one signature of a partner, an officer of the joint venture authorized to bind the venture or an attorney-in-fact. If the bid is signed by an officer of a joint venture or an attorney-in-fact, a document evidencing the individual's authority to execute contracts should be included with the bid form.
- C. A bid from a limited liability company (LLC) shall be signed by a manager or a managing member of the LLC.
- D. A bid from a corporation shall have the correct corporate name thereon and the signature of an authorized officer of the corporation manually written. Title of office held by the person signing for the corporation shall appear, along with typed name of said individual. Corporate license number shall be provided and, if a corporation organized in a state other than Missouri, a Certificate of Authority to do business in the State of Missouri shall be attached. In addition, for corporate proposals, the President or Vice-President should sign as the bidder. If the signator is other than the corporate president or vice president, the bidder must provide satisfactory evidence that the signator has the legal authority to bind the corporation.

- E. A bid should contain the full and correct legal name of the Bidder. If the Bidder is an entity registered with the Missouri Secretary of State, the Bidder's name on the bid form should appear as shown in the Secretary of State's records.
- F. The Bidder should include its corporate license number on the Bid Form and, if the corporation is organized in a state other than Missouri, a Certificate of Authority to do business in the State of Missouri shall be attached to the bid form.

#### **7.0 - RECEIVING BID SUBMITTALS**

- A. It is the bidder's sole responsibility to assure receipt by Owner of bid submittals by the date and time specified in the Invitation for Bid. Bids received after the date and time specified shall not be considered by the Owner.
- B. Bids must be submitted through the MissouriBUYS statewide eProcurement system (<https://www.missouribuys.mo.gov/>) in accordance with the instructions for that system. The Owner shall only accept bids submitted through MissouriBUYS. Bids received by the Owner through any other means, including hard copies, shall not be considered and will be discarded by the Owner unopened.
- C. To respond to an Invitation for Bid, the Bidder must first register with MissouriBUYS by going through the MissouriBUYS Home Page (<https://www.missouribuys.mo.gov/>), clicking the "Register" button at the top of the page, and completing the Vendor Registration. Once registered, the Bidder accesses its account by clicking the "Login" button at the top of the MissouriBUYS Home Page. Enter your USERID and PASSWORD, which the Bidder will select. Under Solicitations, select "View Current Solicitations." A new screen will open. Under "Filter by Agency" select "OA-FMDC-Contracts Chapter 8." Under "Filter by Opp. No." type in the State Project Number. Select "Submit." Above the dark blue bar, select "Other Active Opportunities." To see the Solicitation Summary, single click the Opp. No. (Project Number) and the summary will open. Single quick click each blue bar to open detailed information. The Bidder must read and accept the Original Solicitation Documents and complete all identified requirements. The Bidder should download and save all of the Original Solicitation Documents on its computer so that the Bidder can prepare its response to these documents. The Bidder should upload its completed response to the downloaded documents as an attachment to the electronic solicitation response.
- D. Step-by-step instructions for how a registered vendor responds to a solicitation electronically are provided in Section 001116 – Invitation For Bid.
- E. The Bidder shall submit its bid on the forms provided by the Owner on MissouriBUYS with each space fully and properly completed, including all amounts required for alternate bids, unit prices, cost accounting data, etc. The Owner may reject bids that are not on the Owner's forms or that do not contain all requested information.
- F. No Contractor shall stipulate in his bid any conditions not contained in the specifications or standard bid form contained in the contract documents. To do so may subject the Contractor's bid to rejection.
- G. The completed forms shall be without interlineations, alterations or erasures.

#### **8.0 - MODIFICATION AND WITHDRAWAL OF BIDS**

- A. Bidder may withdraw his bid at any time prior to scheduled closing time for receipt of bids, but no bidder may withdraw his bid for a period of twenty (20) working days after the scheduled closing time for receipt of bids.
- B. The Bidder shall modify his or her original bid by submitting a revised bid on MissouriBUYS.

#### **9.0 - AWARD OF CONTRACT**

- A. The Owner reserves the right to reject any and/or all bids and further to waive all informalities in bidding when deemed in the best interest of the State of Missouri.
- B. The Owner reserves the right to let other contracts in connection with the work, including but not by way of limitation, contracts for the furnishing and installation of furniture, equipment, machines, appliances and other apparatus.

- C. The Owner shall award a contract to the lowest, responsive, responsible Bidder in accordance with Section 8.250, RSMo. No contract will be awarded to any Bidder who has had a contract with the Owner terminated within the preceding twelve months for material breach of contract or who has been suspended or debarred by the Owner.
- D. Award of alternates, if any, will be made in numerical order unless all bids received are such that the order of acceptance of alternates does not affect the determination of the lowest, responsive, responsible bidder.
- E. No bid shall be considered binding upon the Owner until the written contract has been properly executed, a satisfactory bond has been furnished, evidence of required insurance coverage, submittal of executed Section 004541, Affidavit of Work Authorization form, documentation evidencing enrollment and participation in a federal work authorization program has been received and an affirmative action plan submitted. Failure to execute and return the contract and associated documents within the prescribed period of time shall be treated, at the option of the Owner, as a breach of bidder's obligation and the Owner shall be under no further obligation to bidder.
- F. If the successful bidder is doing business in the State of Missouri under a fictitious name, he shall furnish to Owner, attached to the Bid Form, a properly certified copy of the certificate of Registration of Fictitious Name from the State of Missouri, and such certificate shall remain on file with the Owner.
- G. Any successful bidder which is a corporation organized in a state other than Missouri shall furnish to the Owner, attached to the Bid Form, a properly certified copy of its current Certificate of Authority to do business in the State of Missouri, such certificate to remain on file with the Owner. No contract will be awarded by the Owner unless such certificate is furnished by the bidder.
- H. Any successful bidder which is a corporation organized in the State of Missouri shall furnish at its own cost to the Owner, if requested, a Certificate of Good Standing issued by the Secretary of State, such certificate to remain on file with the Owner.
- I. Transient employers subject to Sections 285.230 and 285.234, RSMo, (out-of-state employers who temporarily transact any business in the State of Missouri) may be required to file a bond with the Missouri Department of Revenue. No contract will be awarded by the Owner unless the successful bidder certifies that he has complied with all applicable provisions of Section 285.230-234.
- J. Sections 285.525 and 285.530, RSMo, require business entities to enroll and participate in a federal work authorization program in order to be eligible to receive award of any state contract in excess of \$5,000. Bidders should submit with their bid an Affidavit of Work Authorization (Section 004541) along with appropriate documentation evidencing such enrollment and participation. Section-004541, Affidavit of Work Authorization is located on the MissouriBUYS solicitation for this project. Bidders must also submit an E-Verify Memorandum before the Owner may award a contract to the Bidder. Information regarding an E-Verify is located at <https://www.uscis.gov/e-verify/>. The contractor shall be responsible for ensuring that all subcontractors and suppliers associated with this contract enroll in E-Verify.

#### **10.0 - CONTRACT SECURITY**

- A. The successful bidder shall furnish a performance/payment bond as set forth in General Conditions Article 6.1 on a condition prior to the State executing the contract and issuing a notice to proceed.

#### **11.0 - LIST OF SUBCONTRACTORS**

- A. If required by "Section 004113 – Bid Form," each bidder must submit as part of their bid a list of subcontractors to be used in performing the work (Section 004336). The list must specify the name of the single designated subcontractor, for each category of work listed in "Section 004336 - Proposed Subcontractors Form." If work within a category will be performed by more than one subcontractor, the bidder must provide the name of each subcontractor and specify the exact portion of the work to be done by each. Failure to list the Bidder's firm, or a subcontractor for each category of work identified on the Bid Form or the listing of more than one subcontractor for any category without designating the portion of work to be performed by each shall be cause for rejection of the bid. If the bidder intends to perform any of the designated subcontract work with the use of his own employees, the bidder shall make that fact clear, by listing his own firm for the subject category. **If any category of work is left vacant, the bid shall be rejected.**

## **12.0 - WORKING DAYS**

- A. Contract duration time is stated in working days and will use the following definition in determining the actual calendar date for contract completion:
  - 1. Working days are defined as all calendar days except Saturdays, Sundays and the following State of Missouri observed holidays: New Year's Day, Martin Luther King, Jr. Day, Lincoln Day, Washington's Birthday, Truman Day, Memorial Day, Juneteenth, Independence Day, Labor Day, Columbus Day, Veterans Day, Thanksgiving Day and Christmas Day.

## **13.0 - AMERICAN AND MISSOURI - MADE PRODUCTS AND FIRMS**

- A. By signing the bid form and submitting a bid on this project, the Bidder certifies that it will use American and Missouri products as set forth in Article 1.7 of the General Conditions. Bidders are advised to review those requirements carefully prior to bidding.
- B. A preference shall be given to Missouri firms, corporations or individuals, or firms, corporations or individuals that maintain Missouri offices or places of business, when the quality of performance promised is equal or better and the price quoted is the same or less.
- C. Pursuant to Section 34.076, RSMo, a contractor or Bidder domiciled outside the boundaries of the State of Missouri shall be required, in order to be successful, to submit a bid the same percent less than the lowest bid submitted by a responsible contractor or Bidder domiciled in Missouri as would be required for such a Missouri domiciled contractor or Bidder to succeed over the bidding contractor or Bidder domiciled outside Missouri on a like contract or bid being let in the person's domiciliary state and, further, the contractor or Bidder domiciled outside the boundaries of Missouri shall be required to submit an audited financial statement as would be required of a Missouri domiciled contractor or Bidder on a like contract or bid being let in the domiciliary state of that contractor or Bidder.

## **14.0 – ANTI-DISCRIMINATION AGAINST ISRAEL ACT CERTIFICATION:**

- A. Pursuant to section 34.600, RSMo, if the Bidder meets the section 34.600, RSMo, definition of a “company” and the Bidder has ten or more employees, the Bidder must certify in writing that the Bidder is not currently engaged in a boycott of goods or services from the State of Israel as defined in section 34.600, RSMo, and shall not engage in a boycott of goods or services from the State of Israel, if awarded a contract, for the duration of the contract. The Bidder is requested to complete and submit the applicable portion of Section 004545 - Anti-Discrimination Against Israel Act Certification with their Bid Form. The applicable portion of the exhibit must be submitted prior to execution of a contract by the Owner and issuance of Notice to Proceed. If the exhibit is not submitted, the Owner shall rescind its Intent to Award and move to the next lowest, responsive, responsible bidder.

## **15.0 - MBE/WBE/SDVE INSTRUCTIONS**

- A. Definitions:
  - 1. “**MBE**” means a Minority Business Enterprise.
  - 2. “**MINORITY**” has the same meaning as set forth in 1 C.S.R. 10-17.010.
  - 3. “**MINORITY BUSINESS ENTERPRISE**” has the same meaning as set forth in section 37.020, RSMo.
  - 4. “**WBE**” means a Women’s Business Enterprise.
  - 5. “**WOMEN’S BUSINESS ENTERPRISE**” has the same meaning as set forth in section 37.020, RSMo.
  - 6. “**SDVE**” means a Service-Disabled Veterans Enterprise.
  - 7. “**SERVICE-DISABLED VETERAN**” has the same meaning as set forth in section 34.074, RSMo.
  - 8. “**SERVICE-DISABLED VETERAN ENTERPRISE**” has the same meaning as “Service-Disabled Veteran Business” set forth in section 34.074, RSMo.

B. MBE/WBE/SDVE General Requirements:

1. For all bids greater than \$100,000, the Bidder shall obtain MBE, WBE and SDVE participation in an amount equal to or greater than the percentage goals set forth in the Invitation for Bid and the Bid Form, unless the Bidder is granted a Good Faith Effort waiver by the Director of the Division, as set forth below. If the Bidder does not meet the MBE, WBE and SDVE goals, or make a good faith effort to do so, the Bidder shall be non-responsive, and its bid shall be rejected.
2. The Bidder should submit with its bid all of the information requested in the MBE/WBE/SDVE Compliance Evaluation Form for every MBE, WBE, or SDVE subcontractor or material supplier the Bidder intends to use for the contract work. The Bidder is required to submit all appropriate MBE/WBE/SDVE documentation before the stated time and date set forth in the Invitation for Bid. If the Bidder fails to provide such information by the specified date and time, the Owner shall reject the bid.
3. The Director reserves the right to request additional information from a Bidder to clarify the Bidder's proposed MBE, WBE, and/or SDVE participation. The Bidder shall submit the clarifying information requested by the Owner within two (2) Working Days of receiving the request for clarification.
4. Pursuant to section 34.074, RSMo, a Bidder that is a SDVE doing business as Missouri firm, corporation, or individual, or that maintains a Missouri office or place of business, shall receive a three-point bonus preference in the contract award evaluation process. The bonus preference will be calculated and applied by reducing the bid amount of the eligible SDVE by three percent of the apparent low responsive bidder's bid. Based on this calculation, if the eligible SDVE's evaluation is less than the apparent low responsive bidder's bid, the eligible SDVE's bid becomes the apparent low responsive bid. This reduction is for evaluation purposes only, and will have no impact on the actual amount(s) of the bid or the amount(s) of any contract awarded. In order to be eligible for the SDVE preference, the Bidder must complete and submit with its bid the Missouri Service Disabled Veteran Business Form, and any information required by the form. The form is available on the MissouriBUYS solicitation for this project.

C. Computation of MBE/WBE/SDVE Goal Participation:

1. A Bidder who is a MBE, WBE, or SDVE may count 100% of the contract towards the MBE, WBE or SDVE goal, less any amounts awarded to another MBE, WBE or SDVE. (NOTE: A MBE firm that bids as general contractor must obtain WBE and SDVE participation; a WBE firm that bids as a general contractor must obtain MBE and SDVE participation; and a SDVE firm that bids as general contractor must obtain MBE and WBE participation.) In order for the remaining contract amount to be counted towards the MBE, WBE or SDVE goal, the Bidder must complete the MBE/WBE/SDVE Compliance Evaluation Form (Section 004337) identifying itself as an MBE, WBE or SDVE.
2. The total dollar value of the work granted to a certified MBE, WBE or SDVE by the Bidder shall be counted towards the applicable goal.
3. Expenditures for materials and supplies obtained from a certified MBE, WBE, or SDVE supplier or manufacturer may be counted towards the MBE, WBE and SDVE goals, if the MBE, WBE, or SDVE assumes the actual and contractual responsibility for the provision of the materials and supplies.
4. The total dollar value of the work granted to a second or subsequent tier subcontractor or a supplier may be counted towards a Bidder's MBE, WBE and SDVE goals, if the MBE, WBE, or SDVE properly assumes the actual and contractual responsibility for the work.
5. The total dollar value of work granted to a certified joint venture equal to the percentage of the ownership and control of the MBE, WBE, or SDVE partner in the joint venture may be counted towards the MBE/WBE/SDVE goals.
6. Only expenditures to a MBE, WBE, or SDVE that performs a commercially useful function in the work may be counted towards the MBE, WBE and SDVE goals. A MBE, WBE, or SDVE performs a commercially useful function when it is responsible for executing a distinct element of the work and carrying out its responsibilities by actually performing, managing and supervising the work or providing supplies or manufactured materials.



D. Certification of MBE/WBE/SDVE Subcontractors:

1. In order to be counted towards the goals, an MBE or WBE must be certified by the State of Missouri Office of Equal Opportunity and an SDVE must be certified by the State of Missouri, Office of Administration, Division of Purchasing and Material Management or by the Department of Veterans Affairs.
2. The Bidder may determine the certification status of a proposed MBE or WBE subcontractor or supplier by referring to the Office of Equal Opportunity (OEO)'s online MBE/WBE directory (<https://apps1.mo.gov/MWBCertifiedFirms/>). The Bidder may determine the eligibility of a SDVE subcontractor or supplier by referring to the Division of Purchasing and Materials Management's online SDVE directory (<https://oa.mo.gov/sites/default/files/sdvelisting.pdf>) or the Department of Veterans Affairs' directory (<https://vetbiz.va.gov/basic-search/>).
3. Additional information, clarifications, etc., regarding the listings in the directories may be obtained by calling the Division at (573)751-3339 and asking to speak to the Contract Specialist of record as shown in the Supplementary Conditions (Section 007300).

E. Waiver of MBE/WBE/SDVE Participation:

1. If a Bidder has made a good faith effort to secure the required MBE, WBE and/or SDVE participation and has failed, the Bidder shall submit with its bid the information requested in MBE/WBE/SDVE Good Faith Effort (GFE) Determination form. The GFE forms are located on the MissouriBUYS solicitation for this project. The Director will determine if the Bidder made a good faith effort to meet the applicable goals. If the Director determines that the Bidder did not make a good faith effort, the bid shall be rejected as being nonresponsive to the bid requirements. Bidders who demonstrate that they have made a good faith effort to include MBE, WBE, and/or SDVE participation will be determined to be responsive to the applicable participation goals, regardless of the percent of actual participation obtained, if the bid is otherwise acceptable.
2. In determining whether a Bidder has made a good faith effort to obtain MBE, WBE and/or SDVE participation, the Director may evaluate the factors set forth in 1 CSR 30-5.010(6)(C) and the following:
  - a. The amount of actual participation obtained;
  - b. How and when the Bidder contacted potential MBE, WBE, and SDVE subcontractors and suppliers;
  - c. The documentation provided by the Bidder to support its contacts, including whether the Bidder provided the names, addresses, phone numbers, and dates of contact for MBE/WBE/SDVE firms contacted for specific categories of work;
  - d. If project information, including plans and specifications, were provided to MBE/WBE/SDVE subcontractors;
  - e. Whether the Bidder made any attempts to follow-up with MBE, WBE or SDVE firms prior to bid;
  - f. Amount of bids received from any of the subcontractors and/or suppliers that the Bidder contacted;
  - g. The Bidder's stated reasons for rejecting any bids;
3. If no bidder has obtained any participation in a particular category (MBE/WBE/SDVE) or made a good faith effort to do so, the Director may waive that goal rather than rebid.

F. Contractor MBE/WBE/SDVE Obligations

1. If awarded a contract, the Bidder will be contractually required to subcontract with or obtain materials from the MBE, WBE, and SDVE firms listed in its bid, in amounts equal to or greater than the dollar amount bid, unless the amount is modified in writing by the Owner.
2. If the Contractor fails to meet or maintain the participation requirements contained in the Contractor's bid, the Contractor must satisfactorily explain to the Director why it cannot comply with the requirement and why failing meeting the requirement was beyond the Contractor's control. If the Director finds the Contractor's explanation unsatisfactory, the Director may take any appropriate action including, but not limited to:
  - a. Declaring the Contractor ineligible to participate in any contracts with the Division for up to twelve (12) months (suspension); and/or
  - b. Declaring the Contractor be non-responsive to the Invitation for Bid, or in breach of contract and rejecting the bid or terminating the contract.
3. If the Contractor replaces an MBE, WBE, or SDVE during the course of this contract, the Contractor shall replace it with another MBE, WBE, or SDVE or make a good faith effort to do so. All MBE, WBE and SDVE substitutions must be approved by the Director.
4. The Contractor shall provide the Owner with regular reports on its progress in meeting its MBE/WBE/SDVE obligations. At a minimum, the Contractor shall report the dollar-value of work completed by each MBE, WBE, or SDVE during the preceding month and the cumulative total of work completed by each MBE, WBE or SDVE to date with each monthly application for payment. The Contractor shall also make a final report, which shall include the total dollar-value of work completed by each MBE, WBE, and SDVE during the entire contract.

**STATE OF MISSOURI  
DIVISION OF FACILITIES MANAGEMENT,  
DESIGN AND CONSTRUCTION  
*MBE/WBE/SDVE DIRECTORIES***

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The MBE/WBE Directory for goods and services is maintained by the Office of Equal Opportunity (OEO) and is located at the following web address:

<https://apps1.mo.gov/MWBCertifiedFirms/>

The SERVICE DISABLED VETERAN ENTERPRISE (SDVE) Directories may be accessed at the following web addresses:

<https://o eo.mo.gov/sdve-certification-program/>

<https://veterans.certify.sba.gov/#search>



# State of Missouri Construction Contract

THIS AGREEMENT is made (DATE) by and between:

## *Contractor Name and Address*

hereinafter called the "Contractor,"

and the **State of Missouri**, hereinafter called the "**Owner**", represented by the Office of Administration, Division of Facilities Management, Design and Construction, on behalf of the Department of Public Safety.

WITNESSETH, that the Contractor and the Owner, for the consideration stated herein agree as follows:

## **ARTICLE 1. STATEMENT OF WORK**

The Contractor shall furnish all labor and materials and perform all work required for furnishing and installing all labor, materials, equipment and transportation and everything necessarily inferred from the general nature and tendency of the plans and specifications for the proper execution of the work for:

**Project Name:**                    **Replace HVAC System  
Troop G Headquarters Building - Missouri State Highway Patrol  
Willow Springs, Missouri**

**Project Number:**                **R2313-01**

in strict accordance with the Contract Documents as enumerated in Article 7, all of which are made a part hereof.

## **ARTICLE 2. TIME OF COMPLETION**

The contract performance time is **200 working days** from the transmittal date of this agreement. The contract completion date is **MONTH, DAY, YEAR**. This time includes ten (10) working days for the Contractor to receive, sign and return the contract form along with required bonding and insurance certificates. Failure of the Contractor to provide correct bonding and insurance within the ten (10) working days shall not be grounds for a time extension. Receipt of proper bonding and insurance is a condition precedent to the formation of the contract and if not timely received, may result in forfeiture of the Contractor's bid security. Work may not commence until the Owner issues a written Notice to Proceed and must commence within seven (7) working days thereafter.

## **ARTICLE 3. LIQUIDATED DAMAGES**

Whenever time is mentioned in this contract, time shall be and is of the essence of this contract. The Owner would suffer a loss should the Contractor fail to have the work embraced in this contract fully completed on or before the time above specified. THEREFORE, the parties hereto realize in order to adjust satisfactorily the damages on account of such failure that it might be impossible to compute accurately or estimate the amount of such loss or damages which the Owner would sustain by reason of failure to complete fully said work within the time required by this contract. The Contractor hereby covenants and agrees to pay the Owner, as and for **liquidated damages, the sum of \$1,000** per day for each and every day, Sunday and legal holidays excepted, during which the work remains incomplete and unfinished. Any sum which may be due the Owner for such damages shall be deducted and retained by the Owner from any balance which may be due the Contractor when said work shall have been finished and accepted. But such provisions shall not release the Bond of the Contractor from liability according to its terms. In case of failure to complete, the Owner will be under no obligation to show or prove any actual or specific loss or damage.

**ARTICLE 4. CONTRACT SUM**

The Owner shall pay the Contractor for the prompt, faithful and efficient performance of the conditions and undertakings of this contract, subject to additions, and deductions as provided herein, in current funds the sum of:

Base Bid: \$

**TOTAL CONTRACT AMOUNT: (\$CONTRACT AMOUNT)**

**UNIT PRICES:** The Owner accepts the following Unit Prices:

For changing specified quantities of work from those indicated by the contract drawings and specifications, upon written instructions of Owner, the following unit prices shall prevail. The unit prices include all labor, overhead and profit, materials, equipment, appliances, bailing, shoring, shoring removal, etc., to cover the finished work of the several kinds of work called for. Only a single unit price shall be given and it shall apply for either MORE or LESS work than that shown on the drawings and called for in the specifications or included in the Base Bid. In the event of more or less units than so indicated or included, change orders may be issued for the increased or decreased amount.

**ARTICLE 5. PREVAILING WAGE RATE**

**MISSOURI PREVAILING WAGE LAW (Sections 290.210 to 290.340, RSMo):** The Contractor shall pay not less than the specified hourly rate of wages, as set out in the wage order attached to and made part of the specifications for work under this contract, to all workers performing work under the contract, in accordance with sections 290.210 to 290.340, RSMo. The Contractor shall forfeit a penalty to the Owner of one hundred dollars per day (or portion of a day) for each worker that is paid less than the specified rates for any work done under the contract by the Contractor or by any subcontractor, in accordance with section 290.250, RSMo.

**DAVIS-BACON ACT:** If this Project is financed in whole or in part from Federal funds (as indicated in the Instructions to Bidders or other bid or contract documents for this Project), then this contract shall be subject to all applicable federal labor statutes, rules and regulations, including provisions of the Davis-Bacon Act, 40 U.S.C. §3141 et seq., and the “Federal Labor Standards Provisions,” as further set forth in Section 007333 – Supplementary General Conditions for Federally Funded/Assisted Construction Projects, which is incorporated into the contract by reference. Where the Missouri Prevailing Wage Law and the Davis-Bacon Act require payment of different wages for work performed under this contract, the Contractor and all Subcontractors shall pay the greater of the wages required under either law, on a classification by classification basis.

**ARTICLE 6. MINORITY/WOMEN/SERVICE DISABLED VETERAN BUSINESS ENTERPRISE PARTICIPATION**

The Contractor has been granted a waiver of the 10% MBE and 10% WBE and 3% SDVE participation goals. The Contractor agrees to secure the MBE/WBE/SDVE participation amounts for this project as follows: (OR)

The Contractor has met the MBE/WBE/SDVE participation goals and agrees to secure the MBE/WBE/SDVE participation amounts for this project as follows:

MBE/WBE/SDVE Firm: Subcontract Amt:\$  
MBE/WBE/SDVE Firm: Subcontract Amt:\$  
MBE/WBE/SDVE Firm: Subcontract Amt:\$

Total \$

MBE/WBE/SDVE assignments identified above shall not be changed without a contract change signed by the Owner.

The Director of the Division of Facilities Management, Design and Construction or his Designee shall be the final authority to resolve disputes and disagreements between the Contractor and the MBE/WBE/SDVE firms listed above when such disputes impact the subcontract amounts shown above.

**ARTICLE 7. CONTRACT DOCUMENTS**

The following documents are hereby incorporated into this contract by reference (all division/section numbers and titles are as utilized in the Project Manual published by the Owner for this Project):

1. Division 0 – Procurement and Contracting Information, including, but not limited to:
  - a. Invitation for Bid (Section 001116)
  - b. Instructions to Bidders (Section 002113)
  - c. Supplementary Instructions to Bidders (if applicable) (Section 002213)
  - d. The following documents as completed and executed by the Contractor and accepted by the Owner, if applicable:
    - i. Bid Form (Section 004113)
    - ii. Proposed Contractors Form (Section 004336)
    - iii. MBE, WBE, SDVE Compliance Evaluation Form(s) (Section 004337)
    - iv. MBE, WBE, SDVE Eligibility Determination Form for Joint Ventures (Section 004338)
    - v. MBE, WBE, SDVE Good Faith Effort (GFE) Determination Form (Section 004339)
    - vi. Missouri Service Disabled Veteran Business Form (Section 004340)
    - vii. Affidavit of Work Authorization (Section 004541)
    - viii. Affidavit for Affirmative Action (Section 005414)
  - e. Performance and Payment Bond, completed and executed by the Contractor and surety (Section 006113)
  - f. General Conditions (Section 007213)
  - g. Supplementary Conditions (Section 007300)
  - h. Supplementary General Conditions for Federally Funded/Assisted Construction Projects (Section 007333)
  - i. Wage Rate(s) (Section 007346)
2. Division 1 – General Requirements
3. All Drawings identified in the Project Manual
4. All Technical Specifications included in the Project Manual
5. Addenda, if applicable

**ARTICLE 8 – CERTIFICATION**

By signing this contract, the Contractor hereby re-certifies compliance with all legal requirements set forth in Section 6.0, Bidder’s Certifications of the Bid Form.

Further, if the Contractor provides any “personal information” as defined in §105.1500, RSMo concerning an entity exempt from federal income tax under Section 501(c) of the Internal Revenue Code of 1986, as amended, the Contractor understands and agrees that it is voluntarily choosing to enter into a state contract and providing such information for that purpose. The state will treat such personal information in accord with §105.1500, RSMo.

By signature below, the parties hereby execute this contract document.

**APPROVED:**

\_\_\_\_\_  
Brian Yansen, Director  
Division of Facilities Management,  
Design and Construction

\_\_\_\_\_  
Contractor’s Authorized Signature

I, Corporate Secretary, certify that I am Secretary of the corporation named above and that (CONTRACTOR NAME), who signed said contract on behalf of the corporation, was then (TITLE) of said corporation and that said contract was duly signed for and in behalf of the corporation by authority of its governing body, and is within the scope of its corporate powers.

\_\_\_\_\_  
*Corporate Secretary*



STATE OF MISSOURI  
 OFFICE OF ADMINISTRATION  
 DIVISION OF FACILITIES MANAGEMENT, DESIGN AND CONSTRUCTION  
**AFFIDAVIT FOR AFFIRMATIVE ACTION**

PROJECT NUMBER
----------------

NAME
------

First being duly sworn on oath states: that

he/she is the  sole proprietor  partner  officer or  manager or managing member of

NAME
------

a  sole proprietorship  partnership  
 limited liability company (LLC)

or  corporation, and as such, said proprietor, partner, or officer is duly authorized to make this

affidavit on behalf of said sole proprietorship, partnership, or corporation; that under the contract known as

PROJECT TITLE
---------------

Less than 50 persons in the aggregate will be employed and therefore, the applicable Affirmative Action requirements as set forth in Article 1.4 of the General Conditions of the State of Missouri have been met.

PRINT NAME & SIGNATURE
------------------------

DATE
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**NOTARY INFORMATION**

NOTARY PUBLIC EMBOSSER SEAL	STATE OF	COUNTY (OR CITY OF ST. LOUIS)	USE RUBBER STAMP IN CLEAR AREA BELOW
	SUBSCRIBED AND SWORN BEFORE ME, THIS		
	DAY OF	YEAR	
	NOTARY PUBLIC SIGNATURE	MY COMMISSION EXPIRES	
NOTARY PUBLIC NAME (TYPED OR PRINTED)			

**SECTION 006113 - PERFORMANCE AND PAYMENT BOND FORM**

KNOW ALL MEN BY THESE PRESENTS, THAT we \_\_\_\_\_

as principal, and \_\_\_\_\_

\_\_\_\_\_ as Surety, are held and firmly bound unto the

STATE OF MISSOURI. in the sum of \_\_\_\_\_ Dollars (\$ \_\_\_\_\_ )

for payment whereof the Principal and Surety bind themselves, their heirs, executors, administrators and successors, jointly and severally, firmly by these presents.

WHEREAS, the Principal has, by means of a written agreement dated the \_\_\_\_\_

day of \_\_\_\_\_, 20\_\_\_\_\_, enter into a contract with the State of Missouri for

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

(Insert Project Title and Number)

NOW, THEREFORE, if the Principal shall faithfully perform and fulfill all the undertakings, covenants, terms, conditions and agreements of said contract during the original term of said contract and any extensions thereof that may be granted by the State of Missouri, with or without notice to the Surety and during the life of any guaranty required under the contract; and shall also faithfully perform and fulfill all undertakings, covenants, terms, conditions and agreements of any and all duly authorized modifications of said contract that may hereafter be made with or without notice to the Surety; and shall also promptly make payment for materials incorporated, consumed or used in connection with the work set forth in the contract referred to above, and all insurance premiums, both compensation and all other kinds of insurance, on said work, and for all labor performed on such work, whether by subcontractor or otherwise, at not less than the prevailing hourly rate of wages for work of a similar character (exclusive of maintenance work) in the locality in which the work is performed and not less than the prevailing hourly rate of wages for legal holiday and overtime work (exclusive of maintenance work) in the locality in which the work is performed both as determined by the Department of Labor and Industrial Relations or determined by the Court of Appeal, as provided for in said contract and in any and all duly authorized modifications of said contract that may be hereafter made, with or without notice to the Surety, then, this obligation shall be void and of no effect, but it is expressly understood that if the Principal should make default in or should fail to strictly, faithfully and efficiently do, perform and comply with any or more of the covenants, agreements, stipulations, conditions, requirements or undertakings, as specified in or by the terms of said contract, and with the time therein named, then this obligation shall be valid and binding upon each of the parties hereto and this bond shall remain in full force and effect; and the same may be sued on at the instance of any material man, laborer, mechanic, subcontractor, individual, or otherwise to whom such payment is due, in the name of the State of Missouri, to the use of any such person.



AND, IT IS FURTHER specifically provided that any modifications which may hereinafter be made in the terms of the contract or in the work to be done under it or the giving by the Owner of any extension of the time for the performance of the contract or any other forbearance on the part of either the Owner or the Principal to the other, shall not in any way release the Principal and the Surety, or either or any of them, their heirs, executors, administrators and successors, from their liability hereunder, notice to the Surety of any such extension, modifications or forbearance being hereby waived.

IN WITNESS WHEREOF, the above bounden parties have executed the within instrument this \_\_\_\_\_ day of \_\_\_\_\_, 20 \_\_\_\_.

**AS APPLICABLE:**

**AN INDIVIDUAL**

Name: \_\_\_\_\_  
Signature: \_\_\_\_\_

**A PARTNERSHIP**

Name of Partner: \_\_\_\_\_  
Signature of Partner: \_\_\_\_\_

Name of Partner: \_\_\_\_\_  
Signature of Partner: \_\_\_\_\_

**CORPORATION**

Firm Name: \_\_\_\_\_  
Signature of President: \_\_\_\_\_

**SURETY**

Surety Name: \_\_\_\_\_  
Attorney-in-Fact: \_\_\_\_\_  
Address of Attorney-in-Fact: \_\_\_\_\_  
Telephone Number of Attorney-in-Fact: \_\_\_\_\_  
Signature Attorney-in-Fact: \_\_\_\_\_

**NOTE:** Surety shall attach Power of Attorney



STATE OF MISSOURI  
 OFFICE OF ADMINISTRATION  
 DIVISION OF FACILITIES MANAGEMENT, DESIGN AND CONSTRUCTION  
**PRODUCT SUBSTITUTION REQUEST**

PROJECT NUMBER

PROJECT TITLE AND LOCATION

CHECK APPROPRIATE BOX

- SUBSTITUTION PRIOR TO BID OPENING**  
 (Minimum of (5) working days prior to receipt of Bids as per Article 4 – Instructions to Bidders)
- SUBSTITUTION FOLLOWING AWARD**  
 (Maximum of (20) working days from Notice to Proceed as per Article 3 – General Conditions)

FROM: BIDDER/CONTRACTOR (PRINT COMPANY NAME)

TO: ARCHITECT/ENGINEER (PRINT COMPANY NAME)

Bidder/Contractor hereby requests acceptance of the following product or systems as a substitution in accordance with provisions of Division One of the Bidding Documents:

SPECIFIED PRODUCT OR SYSTEM

SPECIFICATION SECTION NO.

SUPPORTING DATA

- Product data for proposed substitution is attached (include description of product, standards, performance, and test data)
- Sample                       Sample will be sent, if requested

**QUALITY COMPARISON**

	SPECIFIED PRODUCT	SUBSTITUTION REQUEST
NAME, BRAND		
CATALOG NO.		
MANUFACTURER		
VENDOR		

**PREVIOUS INSTALLATIONS**

PROJECT	ARCHITECT/ENGINEER	DATE INSTALLED
LOCATION		

**SIGNIFICANT VARIATIONS FROM SPECIFIED PRODUCT**

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**REASON FOR SUBSTITUTION**

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**DOES PROPOSED SUBSTITUTION AFFECT OTHER PARTS OF WORK?**

YES     NO

IF YES, EXPLAIN

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**SUBSTITUTION REQUIRES DIMENSIONAL REVISION OR REDESIGN OF STRUCTURE OR A/E WORK**

YES     NO

**BIDDER'S/CONTRACTOR'S STATEMENT OF CONFORMANCE OF PROPOSED SUBSTITUTION TO CONTRACT REQUIREMENT:**

We have investigated the proposed substitution. We believe that it is equal or superior in all respects to specified product, except as stated above; that it will provide the same Warranty as specified product; that we have included complete implications of the substitution; that we will pay redesign and other costs caused by the substitution which subsequently become apparent; and that we will pay costs to modify other parts of the Work as may be needed, to make all parts of the Work complete and functioning as a result of the substitution.

BIDDER/CONTRACTOR

DATE

**REVIEW AND ACTION**

Resubmit Substitution Request with the following additional information:

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Substitution is accepted.

Substitution is accepted with the following comments:

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Substitution is not accepted.

ARCHITECT/ENGINEER

DATE



PROJECT NUMBER
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KNOW ALL MEN BY THESE PRESENT THAT:                    hereinafter called "Subcontractor" who heretofore entered into an agreement with                    hereinafter called "Contractor", for the performance of work and/or furnishing of material for the construction of the project entitled

(PROJECT TITLE, PROJECT LOCATION, AND PROJECT NUMBER)

at  
 \_\_\_\_\_  
 (ADDRESS OF PROJECT)

for the State of Missouri (Owner) which said subcontract is by this reference incorporated herein, in consideration of such final payment by Contractor.

DOES HEREBY:

1. ACKNOWLEDGE that they have been **PAID IN FULL** all sums due for work and materials contracted or done by their Subcontractors, Material Vendors, Equipment and Fixture Suppliers, Agents and Employees, or otherwise in the performance of the Work called for by the aforesaid Contract and all modifications or extras or additions thereto, for the construction of said project or otherwise.
2. RELEASE and fully, finally, and forever discharge the Owner from any and all suits, actions, claims, and demands for payment for work performed or materials supplied by Subcontractor in accordance with the requirements of the above referenced Contract.
1. REPRESENT that all of their Employees, Subcontractors, Material Vendors, Equipment and Fixture Suppliers, and everyone else has been **paid in full** all sums due them, or any of them, in connection with performance of said Work, or anything done or omitted by them, or any of them in connection with the construction of said improvements, or otherwise.

DATED this            day of            , 20    .

NAME OF SUBCONTRACTOR
-----------------------

BY (TYPED OR PRINTED NAME)
----------------------------

SIGNATURE
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TITLE
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ORIGINAL: FILE/Closeout Documents



STATE OF MISSOURI  
 OFFICE OF ADMINISTRATION  
 DIVISION OF FACILITIES MANAGEMENT,  
 DESIGN AND CONSTRUCTION

**MBE/WBE/SDVE PROGRESS REPORT**

Remit with **ALL** Progress and Final Payments

(Please check appropriate box) CONSULTANT CONSTRUCTION

PAY APP NO.	PROJECT NUMBER
CHECK IF FINAL <input checked="" type="checkbox"/> <b>FINAL</b>	DATE

PROJECT TITLE

PROJECT LOCATION

FIRM

ORIGINAL CONTRACT SUM (Same as Line Item 1. on Form A of Application for Payment)  
\$

TOTAL CONTRACT SUM TO DATE (Same as Line Item 3. on Form A of Application for Payment)  
\$

THE TOTAL MBE/WBE/SDVE PARTICIPATION DOLLAR AMOUNT OF THIS PROJECT AS INDICATED IN THE ORIGINAL CONTRACT: \$

SELECT MBE, WBE, SDVE	ORIGINAL CONTRACT PARTICIPATION AMOUNT	PARTICIPATION AMOUNT PAID-TO-DATE (includes approved contract changes)	CONSULTANT/SUBCONSULTANT OR CONTRACTOR/SUBCONTRACTOR/SUPPLIER COMPANY NAME
<input type="checkbox"/> MBE <input type="checkbox"/> WBE <input type="checkbox"/> SDVE	\$	\$	
<input type="checkbox"/> MBE <input type="checkbox"/> WBE <input type="checkbox"/> SDVE	\$	\$	
<input type="checkbox"/> MBE <input type="checkbox"/> WBE <input type="checkbox"/> SDVE	\$	\$	
<input type="checkbox"/> MBE <input type="checkbox"/> WBE <input type="checkbox"/> SDVE	\$	\$	
<input type="checkbox"/> MBE <input type="checkbox"/> WBE <input type="checkbox"/> SDVE	\$	\$	
<input type="checkbox"/> MBE <input type="checkbox"/> WBE <input type="checkbox"/> SDVE	\$	\$	

## **INSTRUCTIONS FOR MBE/WBE/SDVE PROGRESS REPORT**

### **CONTRACTOR OR CONSULTANT TO FILL OUT AND REMIT WITH EACH PAY APPLICATION:**

The MBE/WBE/SDVE Progress Report for the project is issued with the contract comprising values reported in the consultant's Proposal or on the successful contractor's Section 004337 Compliance Evaluation Forms.

At Initial Pay Application fill in the following:

1. Pay App No. Start with 1.
2. Fill in the Project Number and Date.
3. Enter Project Title, Project Location, and Firm.
4. Fill in the "Original Contract Sum" and "Total Contract Sum To Date" (Reference applicable Line Items on Form A of Application for Payment).
5. Indicate the Total Participation Dollar Amount from the Original Contract.
6. Select MBE, WBE, or SDVE for each Consultant/Subconsultant or Contractor/Subcontractor/Supplier.
7. Enter the "Total Amount of Subcontract", "\$ Amount (Paid-To-Date)", and Company Name.

For all subsequent Pay Applications fill in the following:

1. Pay App No.
2. If Final Pay App, check box.
3. Fill in the Project Number and Date.
4. Enter Project Title, Project Location, and Firm
5. At each Pay App fill in the "Original Contract Sum" and "Total Contract Sum To Date" (reference applicable Line Items on Form A of Application for Payment).
6. Indicate the Total Participation Dollar Amount from the Original Contract.
7. Select MBE, WBE, or SDVE for each Consultant/Subconsultant or Contractor/Subcontractor/Supplier
8. Enter the "Total Amount of Subcontract", "\$ Amount (Paid-To-Date)", and Company Name.



STATE OF MISSOURI  
 OFFICE OF ADMINISTRATION  
 DIVISION OF FACILITIES MANAGEMENT, DESIGN AND CONSTRUCTION  
**AFFIDAVIT – COMPLIANCE WITH PREVAILING WAGE LAW**

PROJECT NUMBER
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Before me, the undersigned Notary Public, in and for the County of \_\_\_\_\_  
 State of \_\_\_\_\_ personally came and appeared \_\_\_\_\_  
 (NAME)  
 \_\_\_\_\_  
 of the \_\_\_\_\_  
 (POSITION) (NAME OF THE COMPANY)  
 (a corporation) (a partnership) (a proprietorship) and after being duly sworn did depose and say that all provisions and requirements set out in Chapter 290, Sections 290.210 through and including 290.340, Missouri Revised Statutes, pertaining to the payment of wages to workmen employed on public works project have been fully satisfied and there has been no exception to the full and completed compliance with said provisions and requirements and with Wage Determination No: \_\_\_\_\_ issued by the Department of Labor and Industrial Relations, State of Missouri on the \_\_\_\_\_ day of \_\_\_\_\_ 20 \_\_\_\_ in carrying out the contract and working in connection with \_\_\_\_\_  
 (NAME OF PROJECT)  
 Located at \_\_\_\_\_ in \_\_\_\_\_ County  
 (NAME OF THE INSTITUTION)  
 Missouri, and completed on the \_\_\_\_\_ day of \_\_\_\_\_ 20 \_\_\_\_

SIGNATURE

**NOTARY INFORMATION**

NOTARY PUBLIC EMBOSSEER OR BLACK INK RUBBER STAMP SEAL	STATE	COUNTY (OR CITY OF ST. LOUIS)
	SUBSCRIBED AND SWORN BEFORE ME, THIS	
	DAY OF	YEAR
	NOTARY PUBLIC SIGNATURE	MY COMMISSION EXPIRES
NOTARY PUBLIC NAME (TYPED OR PRINTED)		<b>USE RUBBER STAMP IN CLEAR AREA BELOW</b>

FILE: Closeout Documents

# GENERAL CONDITIONS

## INDEX

ARTICLE:

**1. General Provisions**

- 1.1. Definitions
- 1.2. Drawings and Specifications
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- 1.4. Nondiscrimination in Employment
- 1.5. Anti-Kickback
- 1.6. Patents and Royalties
- 1.7. Preference for American and Missouri Products and Services
- 1.8. Communications
- 1.9. Separate Contracts and Cooperation
- 1.10. Assignment of Contract
- 1.11. Indemnification
- 1.12. Disputes and Disagreements

**2. Owner/Designer Responsibilities**

**3. Contractor Responsibilities**

- 3.1. Acceptable Substitutions
- 3.2. Submittals
- 3.3. As-Built Drawings
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- 3.5. Operation and Maintenance Manuals
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- 5.3. Project Completion
- 5.4. Payments

**6. Bond and Insurance**

- 6.1. Bond
- 6.2. Insurance

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- 7.1. For Site Conditions
- 7.2. For Cause
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## SECTION 007213 - GENERAL CONDITIONS

- A. These General Conditions apply to each section of these specifications. The Contractor is subject to the provisions contained herein.
- B. The General Conditions are intended to define the relationship of the Owner, the Designer and the Contractor thereby establishing certain rules and provisions governing the operation and performance of the work so that the work may be performed in a safe, orderly, expeditious and workmanlike manner.

## ARTICLE 1 – GENERAL PROVISIONS

### ARTICLE 1.1 - DEFINITIONS

As used in these contract documents, the following terms shall have the meanings and refer to the parties designated in these definitions.

1. **"COMMISSIONER"**: The Commissioner of the Office of Administration.
2. **"CONSTRUCTION DOCUMENTS"**: The "Construction Documents" shall consist of the Project Manual, Drawings and Addenda.
3. **"CONSTRUCTION REPRESENTATIVE"**: Whenever the term "Construction Representative" is used, it shall mean the Owner's Representative at the work site.
4. **"CONTRACTOR"**: Party or parties who have entered into a contract with the Owner to furnish work under these specifications and drawings.
5. **"DESIGNER"**: When the term "Designer" is used herein, it shall refer to the Architect, Engineer, or Consultant of Record specified and defined in Paragraph 2.0 of the Supplemental Conditions, or his duly authorized representative. The Designer may be either a consultant or state employee.
6. **"DIRECTOR"**: Whenever the term "Director" is used, it shall mean the Director of the Division of Facilities Management, Design and Construction or his Designee, representing the Office of Administration, State of Missouri. The Director is the agent of the Owner.
7. **"DIVISION"**: Shall mean the Division of Facilities Management, Design and Construction, State of Missouri.

8. **"INCIDENTAL JOB BURDENS"**: Shall mean those expenses relating to the cost of work, incurred either in the home office or on the job-site, which are necessary in the course of doing business but are incidental to the job. Such costs include office supplies and equipment, postage, courier services, telephone expenses including long distance, water and ice and other similar expenses.
9. **"JOINT VENTURE"**: An association of two (2) or more businesses to carry out a single business enterprise for profit for which purpose they combine their property, capital, efforts, skills and knowledge.
10. **"OWNER"**: Whenever the term "Owner" is used, it shall mean the State of Missouri, acting by and through the Office of Administration, Division of Facilities Management, Design and Construction.
11. **"PROJECT"**: Wherever the term "Project" is used, it shall mean the work required to be completed by the construction contract.
12. **"PROJECT MANUAL"**: The "Project Manual" shall consist of Introductory Information, Invitation for Bid, Instructions to Bidders, Bid Documents, Additional Information, Standard Forms, General Conditions, Supplemental General Conditions, General Requirements and Technical Specifications.
13. **"SUBCONTRACTOR"**: Party or parties who contract under, or for the performance of part or this entire Contract between the Owner and Contractor. The subcontract may or may not be direct with the Contractor.
14. **"WORK"**: All supervision, labor, materials, tool, supplies, equipment, and any incidental operations and/or activities required by or reasonably inferable from the Contract Documents necessary to construct the Project and to produce the results intended by the Contract Documents in a safe, expeditious, orderly, and workmanlike manner, and in the best manner known to each respective trade.
15. **"WORKING DAYS"**: are all calendar days except Saturdays, Sundays and the following holidays: New Year's Day, Martin Luther King, Jr. Day, Lincoln Day, Washington's Birthday (observed), Truman Day, Memorial Day, Juneteenth, Independence Day, Labor Day, Columbus Day, Veterans Day (observed), Thanksgiving Day, Christmas Day.

## ARTICLE 1.2 DRAWINGS AND SPECIFICATIONS

- A. In case of discrepancy between drawings and specifications, specifications shall govern. Should discrepancies in architectural drawings, structural drawings and mechanical drawings occur, architectural drawings shall govern and, in case of conflict between structural and mechanical drawings, structural drawings shall govern.
- B. Specifications are separated into titled divisions for convenience of reference only and to facilitate letting of contracts and subcontracts. The Contractor is responsible for establishing the scope of work for subcontractors, which may cross titled divisions. Neither the Owner nor Designer will establish limits and jurisdiction of subcontracts.
- C. Figured dimensions take precedence over scaled measurements and details over smaller scale general drawings. In the event of conflict between any of the documents contained within the contract, the documents shall take precedence and be controlling in the following sequence: addenda, supplementary general conditions, general conditions, division 1 specifications, technical division specifications, drawings, bid form and instructions to bidders.
- D. Anything shown on drawings and not mentioned in these specifications or vice versa, as well as any incidental work which is obviously necessary to complete the project within the limits established by the drawings and specifications, although not shown on or described therein, shall be performed by the Contractor at no additional cost as a part of his contract.
- E. Upon encountering conditions differing materially from those indicated in the contract documents, the Contractor shall promptly notify the Designer and Construction Representative in writing before such conditions are disturbed. The Designer shall promptly investigate said conditions and report to the Owner, with a recommended course of action. If conditions do materially differ and cause an increase or decrease in contract cost or time required for completion of any portion of the work, a contract change will be initiated as outlined in Article 4 of these General Conditions.
- E. Only work included in the contract documents is authorized, and the Contractor shall do no work other than that described therein or in accordance with appropriately authorized and approved contract changes.

## ARTICLE 1.3 - COMPLIANCE WITH LAWS, PERMITS, REGULATIONS AND INSPECTIONS

- A. Since the Owner is the State of Missouri, municipal or political subdivisions, zoning ordinances, construction codes (other than licensing of trades), and other like ordinances are not applicable to construction on Owner's property, and Contractor will not be required to submit drawings and specifications to any municipal or political subdivision, authority, obtain construction permits or any other licenses (other than licensing of trades) or permits from or submit to inspections by any municipality or political subdivision relating to the construction for this project. All permits or licenses required by municipality or political subdivision for operation on property not belonging to Owner shall be obtained by and paid for by Contractor. Each Contractor shall comply with all applicable laws, ordinances, rules and regulations that pertain to the work of this contract.
- B. Contractors, subcontractors and their employees engaged in the businesses of electrical, mechanical, plumbing, carpentry, sprinkler system work, and other construction related trades shall be licensed to perform such work by the municipal or political subdivision where the project is located, if such licensure is required by local code. Local codes shall dictate the level (master, journeyman, and apprentice) and the number, type and ratio of licensed tradesmen required for this project within the jurisdiction of such municipal or political subdivision.
- C. Equipment and controls manufacturers and their authorized service and installation technicians that do not maintain an office within the jurisdiction of the municipal or political subdivision but are a listed or specified contractor or subcontractor on this project are exempt from Paragraph 1.3 B above.
- D. The Contractor shall post a copy of the wage determination issued for the project and included as a part of the contract documents, in a prominent and easily accessible location at the site of construction for the duration of the project.
- E. Any contractor or subcontractor to such contractor at any tier signing a contract to work on this project shall provide a ten-hour Occupational Safety and Health Administration (OSHA) construction safety program for their on-site employees which includes a course in construction safety and health approved by OSHA or a similar program approved by the Department of Labor and Industrial Relations which is at least as stringent as an approved OSHA program. The contractor shall

forfeit as a penalty to the public body on whose behalf the contract is made or awarded, two thousand five hundred dollars plus one hundred dollars for each employee employed by the contractor or subcontractor, for each calendar day, or portion thereof, such employee is employed without the required training.

#### **ARTICLE 1.4 - NONDISCRIMINATION IN EMPLOYMENT**

A. The Contractor and his subcontractors will not discriminate against individuals based on race, color, religion, national origin, sex, disability, or age, but may use restrictions which relate to bona fide occupational qualifications. Specifically, the Contractor and his subcontractors shall not discriminate:

1. Against recipients of service on the basis of race, color, religion, national origin, sex, disability or age.
2. Against any employee or applicant, for employment on the basis of race, color, religion, national origin, sex or otherwise qualified disability status.
3. Against any applicant for employment or employee on the basis of age, where such applicant or employee is between ages 40 and 70 and where such Contractor employs at least 20 persons.
4. Against any applicant for employment or employee on the basis of that person's status as a disabled or Vietnam-era veteran.

The Contractor and his Subcontractors will take affirmative action to insure applicants for employment and employees are treated equally without regard to race, color, religion, national origin, sex, disability, or age. Such action shall include, but not be limited to, the following: employment, upgrading, demotion and transfer; recruitment or recruitment advertising; and selection for training, including apprenticeship. The Contractor and his Subcontractors will give written notice of their commitments under this clause to any labor union with which they have bargaining or other agreements.

B. The Contractor and his subcontractors shall develop, implement, maintain and submit in writing to the Owner an affirmative action program if at least fifty (50) persons in the aggregate are employed under this contract. If less than fifty (50) persons in the aggregate are to be employed under this contract, the Contractor shall submit, in lieu of the written affirmative action program, a properly executed Affidavit for Affirmative Action

in the form included in the contract specifications. For the purpose of this section, an "affirmative action program" means positive action to influence all employment practices (including, but not limited to, recruiting, hiring, promoting and training) in providing equal employment opportunity regardless of race, color, sex, national origin, religion, age (where the person affected is between age 40 and 70), disabled and Vietnam-era veteran status, and disability. Such "affirmative action program" shall include:

1. A written policy statement committing the total organization to affirmative action and assigning management responsibilities and procedures for evaluation and dissemination;
2. The identification of a person designated to handle affirmative action;
3. The establishment of non-discriminatory selection standards, objective measures to analyze recruitment, an upward mobility system, a wage and salary structure, and standards applicable to lay-off, recall, discharge, demotion and discipline;
4. The exclusion of discrimination from all collective bargaining agreements; and
5. Performance of an internal audit of the reporting system to monitor execution and to provide for future planning.

In the enforcement of this non-discrimination clause, the Owner may use any reasonable procedures available, including, but not limited to: requests, reports, site visits and inspection of relevant documents of contractors and subcontractors.

C. In the event of the Contractor's or his subcontractor's noncompliance with any provisions of this Article of the Contract, the Owner may cancel this contract in whole or in part or require the Contractor to terminate his contract with the subcontractor.

#### **ARTICLE 1.5 - ANTI-KICKBACK**

No employee of the division, shall have or acquire any pecuniary interest, whether direct or indirect, in this contract or in any part hereof. No officer, employee, designer, attorney, or administrator of or for the Owner who is authorized in such capacity and on behalf of the Owner to exercise any legislative, executive, supervisory or other similar functions in connection with the construction of the project, shall have or acquire any pecuniary interest, whether direct or indirect, in this contract, any material supply contract, subcontract,

insurance contract, or any other contract pertaining to the project.

#### **ARTICLE 1.6 - PATENTS AND ROYALTIES**

- A. The Contractor shall hold and save the Owner and its officers, agents, servants and employees harmless from liabilities of any nature or kind, including cost and expenses, for, or on account of, any patented or unpatented invention, process, article or appliance manufactured or used in the performance of this contract, including its use by the Owner, unless otherwise specifically stipulated in the contract documents.
- B. If the Contractor uses any design, device or materials covered by letters, patent or copyright, the Contractor shall provide for such use by suitable agreement with the Owner of such patented or copyrighted design, device or material. It is mutually agreed and understood, without exception, that the contract prices shall include all royalties or costs arising from the use of such design, device or materials, in any way involved in the work. The Contractor and/or his sureties shall indemnify and save harmless the Owner of the project from any and all claims for infringement by reason of the use of such patented or copyrighted design, device or materials or any trademark or copyright in connection with work agreed to be performed under this contract and shall indemnify the Owner for any cost, expense or damage it may be obliged to pay by reason of such infringement at any time during the prosecution of the work or after completion of the work.

#### **ARTICLE 1.7 - PREFERENCE FOR AMERICAN AND MISSOURI PRODUCTS AND SERVICES**

- A. By virtue of statutory authority a preference will be given to Missouri labor and to products of mines, forests and quarries of the state of Missouri when they are found in marketable quantities in the state, and all such materials shall be of the best quality and suitable character that can be obtained at reasonable market prices, all as provided for in Section 8.280, Missouri Revised Statutes and Cumulative Supplements.
- B. Furthermore, pursuant to Section 34.076 Missouri Revised Statutes and Cumulative Supplements, a preference shall be given to those persons doing business as Missouri firms, corporations, or individuals, or which maintain Missouri offices or places of business, when the quality of performance promised is equal or better and the price quoted is the same or less. In addition, in order for a non-domiciliary bidder to be successful, his bid must be that same percentage lower than a domiciliary Missouri bidder's bid, as would be

required for a Missouri bidder to successfully bid in the non-domiciliary state.

- C. In accordance with the Missouri Domestic Products Procurement Act Section 34.350 RSMo and Cumulative Supplements any manufactured goods or commodities used or supplied in the performance of this contract or any subcontract thereto shall be manufactured, assembled or produced in the United States, unless the specified products are not manufactured, assembled or produced in the United States in sufficient quantities to meet the agency's requirements or cannot be manufactured, assembled or produced in the United States within the necessary time in sufficient quantities to meet the contract requirements, or if obtaining the specified products manufactured, assembled or produced in the United States would increase the cost of this contract for purchase of the product by more than ten percent.

#### **ARTICLE 1.8 - COMMUNICATIONS**

- A. All notices, requests, instructions, approvals and claims must be in writing and shall be delivered to the Designer and copied to the Construction Representative for the project except as required by Article 1.12 Disputes and Disagreements, or as otherwise specified by the Owner in writing as stated in Section 012600. Any such notice shall be deemed to have been given as of the time of actual receipt.
- B. The Contractor shall attend on-site progress and coordination meetings, as scheduled by the Construction Representative, no less than once a month.
- C. The Contractor shall ensure that major subcontractors and suppliers shall attend monthly progress meetings as necessary to coordinate the work, and as specifically requested by the Construction Representative.

#### **ARTICLE 1.9 - SEPARATE CONTRACTS AND COOPERATION**

- A. The Owner reserves the right to let other contracts in connection with this work. The Contractor shall afford other contractors reasonable opportunity for the introduction and storage of their materials and the execution of their work and shall properly connect and coordinate his work with theirs.
- B. The Contractor shall consult the drawings for all other contractors in connection with this work. Any work conflicting with the above shall be brought to the attention of the Owner's Representative before the work is performed. If the Contractor fails to do this, and constructs any

work which interferes with the work of another contractor, the Contractor shall remove any part so conflicting and rebuild same, as directed by the Owner's Representative at no additional cost to the Owner.

- C. Each contractor shall be required to coordinate his work with other contractors so as to afford others reasonable opportunity for execution of their work. No contractor shall delay any other contractor by neglecting to perform contract work at the proper time. If any contractor causes delay to another, they shall be liable directly to that contractor for such delay in addition to any liquidated damages which might be due the Owner.
- D. Should the Contractor or project associated subcontractors refuse to cooperate with the instructions and reasonable requests of other Contractors or other subcontractors in the overall coordinating of the work, the Owner may take such appropriate action and issue directions, as required, to avoid unnecessary and unwarranted delays.
- E. Each Contractor shall be responsible for damage done to Owner's or other Contractor's property by him/her or workers in his employ through their fault or negligence.
- F. Should a Contractor sustain any damage through any act or omission of any other Contractor having a contract with the Owner, the Contractor so damaged shall have no claim or cause of action against the Owner for such damage, but shall have a claim or cause of action against the other Contractor to recover any and all damages sustained by reason of the acts or omissions of such Contractor. The phrase "acts or omissions" as used in this section shall be defined to include, but not be limited to, any unreasonable delay on the part of any such contractors.

#### **ARTICLE 1.10 - ASSIGNMENT OF CONTRACT**

- A. No assignment by Contractor of any amount or any part of this contract or of the funds to be received there under will be recognized unless such assignment has had the written approval of the Director and the surety has been given due notice of such assignment and has furnished written consent thereto. In addition to the usual recitals in assignment contracts, the following language must be set forth: "It is agreed that the funds to be paid to the assignee under this assignment are subject to performance by the Contractor of this contract and to claims or liens for services rendered or materials supplied for the performance of the work called for in said contract in favor of all persons, firms or corporations rendering such services or supplying such materials."

#### **ARTICLE 1.11 - INDEMNIFICATION**

- A. Contractor agrees to indemnify and save harmless Owner and its respective commissioners, officers, officials, agents, consultants and employees and Designer, their agents, servants and employees, from and against any and all liability for damage arising from injuries to persons or damage to property occasioned by any acts or omissions of Contractor, any subcontractors, agents, servants or employees, including any and all expense, legal or otherwise, which may be incurred by Owner or Designer, its agents, servants or employees, in defense of any claim, action or suit.
- B. The obligations of the Contractor under this paragraph shall not extend to the liability of the Designer, his agents or employees, arising out of (1) the preparation or approval of maps, drawings, opinions, reports, surveys, contract changes, design or specifications, or (2) giving of or the failure to give directions or instructions by the Designer, his agents or employees as required by this contract documents provided such giving or failure to give is the primary cause of the injury or damage.

#### **ARTICLE 1.12 - DISPUTES AND DISAGREEMENTS**

It is hereby expressly agreed and understood that in case any controversy or difference of opinion arises during construction, best efforts will be given to resolution at the field level. Should those efforts be unsuccessful, the Contractor has the right to appeal in writing, the decision of the Director's Designee to the Director at Room 730 Truman Building, P.O. Box 809, Jefferson City, Missouri 65102. The decision of the Director shall be final and binding on all parties.

#### **ARTICLE 2 -- OWNER/DESIGNER RESPONSIBILITIES**

- A. The Owner shall give all orders and directions contemplated under this contract relative to the execution of the work. During progress of work the Owner will be represented at the project site by the Construction Representative and/or Designer, whose responsibilities are to see that this contract is properly fulfilled.
- B. The Owner shall at all times have access to the work whenever it is in preparation or progress. The Contractors shall provide proper facilities for such access and for inspection and supervision.
- C. All materials and workmanship used in the work shall be subject to the inspection of the Designer and Construction Representative, and any work which is deemed defective shall be removed, rebuilt or made good immediately upon notice.

The cost of such correction shall be borne by the Contractor. Contractor shall not be entitled to an extension of the contract completion date in order to remedy defective work. All rejected materials shall be immediately removed from the site of the work.

- D. If the Contractor fails to proceed at once with the correction of rejected defective materials or workmanship, the Owner may, by separate contract or otherwise, have the defects remedied or rejected. Materials removed from the site and charge the cost of the same against any monies which may be due the Contractor, without prejudice to any other rights or remedies of the Owner.
- E. Failure or neglect on the part of Owner to observe faulty work, or work done which is not in accordance with the drawings and specifications shall not relieve the Contractor from responsibility for correcting such work without additional compensation.
- F. The Owner shall have the right to direct the Contractor to uncover any completed work.
  - 1. If the Contractor fails to adequately notify the Construction Representative and/or Designer of an inspection as required by the Contract Documents, the Contractor shall, upon written request, uncover the work. The Contractor shall bear all costs associated with uncovering and again covering the work exposed.
  - 2. If the Contractor is directed to uncover work, which was not otherwise required by the Contract Documents to be inspected, and the work is found to be defective in any respect, no compensation shall be allowed for this work. If, however, such work is found to meet the requirements of this contract, the actual cost of labor and material necessarily involved in the examination and replacement plus 10% shall be allowed the Contractor.
- G. The Designer shall give all orders and directions contemplated under this contract relative to the scope of the work and shall give the initial interpretation of the contract documents.
- H. The Owner may file a written notice to the Contractor to dismiss immediately any subcontractors, project managers, superintendents, foremen, workers, watchmen or other employees whom the Owner may deem incompetent, careless or a hindrance to proper or timely execution of the work. The Contractor shall comply with such notice as promptly as practicable without detriment to the work or its progress.

- I. If in the Owner's judgment it becomes necessary at any time to accelerate work, when ordered by the Owner in writing, the Contractor shall redirect resources to such work items and execute such portions of the work as may be required to complete the work within the current approved contract schedule.

### **ARTICLE 3 -- CONTRACTOR RESPONSIBILITIES**

The Contractor shall register and utilize the Owner's eBuilder digital project management system for submission of documents described in the following sections. This includes but is not limited to submittals as required by designer, payment applications, Request for Information (RFI), construction change orders, Request for Proposals (RFP), Designer Supplemental Instructions (DSI), etc.

#### **ARTICLE 3.1 -- ACCEPTABLE SUBSTITUTIONS**

- A. The Contractor may request use of any article, device, product, material, fixture, form or type of construction which in the judgment of the Owner and Designer is equal in all respects to that named. Standard products of manufacturers other than those specified will be accepted when, prior to the ordering or use thereof, it is proven to the satisfaction of the Owner and Designer that they are equal in design, strength, durability, usefulness and convenience for the purpose intended.
- B. Any changes required in the details and dimensions indicated on the drawings for the substitution of products other than those specified shall be properly made at the expense of the Contractor requesting the substitution or change.
- C. The Contractor shall submit a request for such substitutions in writing to the Owner and Designer within twenty (20) working days after the date of the "Notice to Proceed." Thereafter no consideration will be given to alternate forms of accomplishing the work. This Article does not preclude the Owner from exercising the provisions of Article 4 hereof.
- D. Any request for substitution by the Contractor shall be submitted in accordance with SECTION 002113 - INSTRUCTIONS TO BIDDERS.
- E. When a material has been approved, no change in brand or make will be permitted unless:
  - 1. Written verification is received from the manufacturer stating they cannot make delivery on the date previously agreed, or
  - 2. Material delivered fails to comply with contract requirements.

**ARTICLE 3.2 -- SUBMITTALS**

- A. The Contractor’s submittals must be submitted with such promptness as to allow for review and approval so as not to cause delay in the work. The Contractor shall coordinate preparation and processing of submittals with performance of construction activities.

Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.

Submit four (4) copies to the Designer and additional copies as required for the subcontractors and material suppliers. Also provide copies to meet the requirements for maintenance manuals.

- B. All subcontractors' shop drawings and schedules shall be submitted by the Contractor and shall bear evidence that Contractor has received, reviewed, and approved them. Any shop drawings and schedules submitted without this evidence will be returned to the Contractor for resubmission.
- C. The Contractor shall include with the shop drawing, a letter indicating any and all deviations from the drawings and/or specifications. Failure to notify the Designer of such deviations will be grounds for subsequent rejection of the related work or materials. If, in the opinion of the Designer, the deviations are not acceptable, the Contractor will be required to furnish the item as specified and indicated on the drawings.
- D. The Designer shall check shop drawings and schedules with reasonable promptness and approve them only if they conform to the design concept of the project and comply with the information given in the contract documents. The approval shall not relieve the Contractor from the responsibility to comply with the drawings and specifications, unless the Contractor has called the Designer's attention to the deviation, in writing, at the time of submission and the Designer has knowingly approved thereof. An approval of any such modification will be given only under the following conditions:
  - 1. It is in the best interest of the Owner
  - 2. It does not increase the contract sum and/or completion time
  - 3. It does not deviate from the design intent
  - 4. It is without prejudice to any and all rights under the surety bond.
- E. No extension of time will be granted because of the Contractor's failure to submit shop drawings and schedules in ample time to allow for review,

possible resubmission, and approval. Fabrication of work shall not commence until the Contractor has received approval. The Contractor shall furnish prints of approved shop drawings and schedules to all subcontractors whose work is in any way related to the work under this contract. Only prints bearing this approval will be allowed on the site of construction

- F. The Contractor shall maintain a complete file on-site of approved shop drawings available for use by the Construction Representative.

**ARTICLE 3.3 – AS-BUILT DRAWINGS**

- A. The Contractor shall update a complete set of the construction drawings, shop drawings and schedules of all work monthly by marking changes, and at the completion of their work (prior to submission of request for final payment) note all changes and turn the set over to the Construction Representative. The updates shall show all addenda, all field changes that were made to adapt to field conditions, changes resulting from contract changes or supplemental instructions, and all locations of structures, buried installations of piping, conduit, and utility services. All buried and concealed items both inside and outside shall be accurately located as to depth and referenced to permanent features such as interior or exterior wall faces and dimensions shall be given in a neat and legible manner in a contrasting colored pencil or ink. If approved by the Designer, an electronic file format may be provided.

**ARTICLE 3.4 – GUARANTY AND WARRANTIES**

- A. General Guaranty
  - 1. Neither the final certificate of payment nor any provision in the contract documents nor partial use or occupancy of the premises by the Owner shall constitute an acceptance of work not done in accordance with contract requirements.
  - 2. The Contractor or surety shall remedy any defects in the work and pay for any damage to property resulting there from which shall appear within a period of one (1) year from the date of substantial completion unless a longer period is otherwise specified or a differing guaranty period has been established in the substantial completion certificate. The Owner will give notice of observed defects with reasonable promptness.
  - 3. In case of default on the part of the Contractor in fulfilling this part of this contract, the Owner may correct the work or repair the

damage and the cost and expense incurred in such event shall be paid by or recoverable from the Contractor or surety.

4. The work will be free from defects not inherent in the quality required or permitted, and that the Work will conform to the requirements of the Contract Documents. Work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective. The Contractor's guaranty excludes remedy for damage or defect caused by abuse, modifications not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear under normal usage. If required by the Owner, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment

**B. Extended Warranty**

Manufacturer's certificates of warranty shall be obtained for all major equipment. Warranty shall be obtained for at least one year. Where a longer period is offered at no additional cost or called for in the specific equipment specifications, the longer period shall govern.

**ARTICLE 3.5 -- OPERATION AND MAINTENANCE MANUALS**

- A. Immediately after equipment submittals are approved and no later than ten (10) working days prior to the substantial completion inspection, the Contractor shall provide to the Designer three (3) copies of operating instructions and service manuals, containing the following:

1. Start-up and Shut-down Procedures: Provide a step-by-step write up of all major equipment. When manufacturer's printed start-up, trouble shooting and shut-down procedures are available; they may be incorporated into the operating manual for reference.
2. Operating Instructions: Written operating instructions shall be included for the efficient and safe operation of all equipment.
3. Equipment List: List of all major equipment as installed shall be prepared to include model number, capacities, flow rate, name place data, shop drawings and air and water balance reports.
4. Service Instructions: Provide the following information for all pieces of equipment.

- a. Recommended spare parts including catalog number and name of local supplier or factory representative.
- b. Belt sizes, types, and lengths.
- c. Wiring diagrams.

5. Manufacturer's Certificate of Warranty as described in Article 3.4.

6. Prior to the final payment, furnish to the Designer three (4) copies of parts catalogs for each piece of equipment furnished by him/her on the project with the components identified by number for replacement ordering.

- B. Submission of operating instructions shall be done in the following manner.

1. Manuals shall be in quadruplicate, and all materials shall be bound into volumes of standard 8½" x 11" hard binders. Large drawings too bulky to be folded into 8½" x 11" shall be separately bound or folded and in envelopes, cross referenced and indexed with the manuals.

2. The manuals shall identify project name, project number, and include the name and address of the Contractor, subcontractors and manufacturers who were involved with the activity described in that particular manual.

3. Internally subdivide the binder contents with permanent page dividers, logically organized with tab titles clearly printed under reinforced laminated plastic tabs.

4. Contents: Prepare a Table of Contents for each volume, with each product or system description identified.

**ARTICLE 3.6 – OTHER CONTRACTOR RESPONSIBILITIES**

- A. The Contractor shall keep on site, during progress of the work, a competent superintendent satisfactory to the Construction Representative. The superintendent shall represent the Contractor and all agreements made by the superintendent shall be binding. The superintendent shall carefully study and compare all drawings, specifications and other instructions and shall promptly notify the Construction Representative and Designer, in writing, any error, inconsistency or omission which may be discovered. The superintendent shall coordinate all work on the project. Any change of the superintendent shall be approved by the Construction Representative.
- B. Contractor shall, at all times, enforce strict discipline and good order among his employees,



and shall not employ on the work any unfit person or anyone not skilled in the work assigned to him/her.

- C. The Contractor shall supply sufficient labor, material, plant and equipment and pay when due any laborer, subcontractor or supplier for supplies furnished and otherwise prosecute the work with diligence to prevent work stoppage and insure completion thereof within the time specified.
- D. The Contractor and each of his subcontractors shall submit to the Construction Representative, through the Designer such schedules of quantities and costs, progress schedules, payrolls, reports, estimates, records and other data as the Owner may request concerning work performed or to be performed under this contract.
- E. The Contractor, subcontractors, and material suppliers shall upon written request, give the Owner access to all time cards, material invoices, payrolls, estimates, profit and loss statements, and all other direct or indirect costs related to this work.
- F. The Contractor shall be responsible for laying out all contract work such as layout of architectural, structural, mechanical and electrical work, which shall be coordinated with layouts of subcontractors for general construction work. The Contractor is also responsible for unloading, uncrating and handling of all materials and equipment to be erected or placed by him/her, whether furnished by Contractor or others. No extra charges or compensation will be allowed as a result of failure to verify dimensions before ordering materials or fabricating items.
- G. The Contractor must notify the Construction Representative at least one working day before placing concrete or burying underground utilities, pipelines, etc.
- H. Contractors shall prearrange time with the Construction Representative for the interruption of any facility operation. Unless otherwise specified in these documents, all connections, alterations or relocations as well as all other portions of the work will be performed during normal working hours.
- I. The Contractor shall coordinate all work so there will not be prolonged interruptions of existing equipment operation. Any existing plumbing, heating, ventilating, air conditioning or electrical disconnections necessary for the project, which affect portions of this construction or building or any other building must be scheduled with the Construction Representative to minimize or avoid any disruption of facility operations. In no case,

unless previously approved in writing by the Construction Representative, shall utilities be left disconnected at the end of a work day or over a weekend. Any interruption of utilities either intentionally or accidentally shall not relieve the Contractor responsible for the interruption from the responsibility to repair and restore the utility to normal service. Repairs and restoration shall be made before the workers responsible for the repair and restoration leave the job.

- J. Contractors shall limit operations and storage of materials to the area within the project, except as necessary to connect to existing utilities, and shall not encroach on neighboring property. The Contractor shall be responsible for repair of their damage to property on or off the project site occurring during construction of project. All such repairs shall be made to the satisfaction of the property owner.
- K. Unless otherwise permitted, all materials shall be new and both workmanship and materials shall be of the best quality.
- L. Unless otherwise provided and stipulated within these specifications, the Contractor shall furnish, construct, and/or install and pay for materials, devices, mechanisms, equipment, all necessary personnel, utilities including, but not limited to water, heat, light and electric power, transportation services, applicable taxes of every nature, and all other facilities necessary for the proper execution and completion of the work.
- M. Contractor shall carefully examine the plans and drawings and shall be responsible for the proper fitting of his material, equipment and apparatus into the building.
- N. The Contractor or subcontractors shall not overload, or permit others to overload, any part of any structure during the performance of this contract.
- O. All temporary shoring, bracing, etc., required for the removal of existing work and/or for the installation of new work shall be included in this contract. The Contractor shall make good, at no cost to the Owner, any damage caused by improper support or failure of shoring in any respect. Each Contractor shall be responsible for shoring required to protect his work or adjacent property and improvements of Owner and shall be responsible for shoring or for giving written notice to adjacent property owners. Shoring shall be removed only after completion of permanent supports.

- P. The Contractor shall provide at the proper time such material as is required for support of the work. If openings are required, whether shown on drawings or not, the Contractor shall see that they are properly constructed.
- Q. During the performance of work the Contractor shall be responsible for providing and maintaining warning signs, lights, signal devices, barricades, guard rails, fences and other devices appropriately located on site which will give proper and understandable warning to all persons of danger of entry onto land, structure or equipment.
- R. The Contractor shall be responsible for protection, including weather protection, and proper maintenance of all equipment and materials.
- S. The Contractor shall be responsible for care of the finished work and shall protect same from damage or defacement until substantial completion by the Owner. If the work is damaged by any cause, the Contractor shall immediately begin to make repairs in accordance with the drawings and specifications. Contractor shall be liable for all damage or loss unless attributable to the acts or omissions of the Owner or Designer. Any claim for reimbursement shall be submitted in accordance with Article 4. After substantial completion the Contractor will only be responsible for damage resulting from acts or omissions of the Contractor or subcontractors through final warranty.
- T. In the event the Contractor encounters an unforeseen hazardous material, the Contractor shall immediately stop work in the area affected and report the condition to the Owner and Designer in writing. The Contractor shall not be required, pursuant to Article 4, to perform, any work relating to hazardous materials.
- U. In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency shall be determined as provided in Article 4.
- V. Before commencing work, Contractors shall confer with the Construction Representative and facility representative and review any facility rules and regulations which may affect the conduct of the work.
- W. Project signs will only be erected on major projects and only as described in the specifications. If no sign is specified, none shall be erected.

## **ARTICLE 3.7 -- SUBCONTRACTS**

- A. Subcontractor assignments as identified in the bid form shall not be changed without written approval of the Owner. The Owner will not approve changes of a listed subcontractor unless the Contractor documents, to the satisfaction of the Owner that the subcontractor cannot or will not perform the work as specified.
- B. The Contractor is fully responsible to the Owner for the acts and omissions of all subcontractors and of persons either directly or indirectly employed by them.
- C. Every subcontractor shall be bound by the applicable terms and provisions of these contract documents, but no contractual relationship shall exist between any subcontractor and the Owner unless the right of the Contractor to proceed with the work is suspended or this contract is terminated as herein provided, and the Owner in writing elects to assume the subcontract.
- D. The Contractor shall upon receipt of "Notice to Proceed" and prior to submission of the first payment request, notify the Designer and Construction Representative in writing of the names of any subcontractors to be used in addition to those identified in the bid form and all major material suppliers proposed for all parts of the work.

## **ARTICLE 4 -- CHANGES IN THE WORK**

### **4.1 CHANGES IN THE WORK**

- A. The Construction Representative, without giving notice to the surety and without invalidating this contract, may order extra work or make changes by altering, adding to or deducting from the work, this contract sum being adjusted accordingly. All such work shall be executed under the conditions of the original contract. A claim for extension of time caused by any change must be adjusted at the time of ordering such change. No future request for time will be considered.
- B. Each Contract Change shall include all costs required to perform the work including all labor, material, equipment, overheads and profit, delay, disruptions, or other miscellaneous expenses. No subsequent requests for additional compensation including claims for delay, disruption, or reduced efficiency as a result of each change will be considered. Values from the Schedule of Values will not be binding as a basis for additions to or deductions from the contract price.
- C. The amount of any adjustment in this contract price for authorized changes shall be agreed upon

before such changes become effective and shall be determined, through submission of a request for proposal, as follows:

1. By an acceptable fixed price proposal from the Contractor. Breakdowns shall include all takeoff sheets of each Contractor and subcontractor. Breakdown shall include a listing of each item of material with unit prices and number of hours of labor for each task. Labor costs per hour shall be included with labor burden identified, which shall be not less than the prevailing wage rate, etc. Overhead and profit shall be shown separately for each subcontractor and the Contractor.
2. By a cost-plus-fixed-fee (time and material) basis with maximum price, total cost not to exceed said maximum. Breakdown shall include a listing of each item of material with unit prices and number of hours of labor for each task. Labor costs per hour shall be included with labor burden identified, which shall be not less than the prevailing wage rate, etc. Overhead and profit shall be shown separately for each subcontractor and the Contractor.
3. By unit prices contained in Contractor's original bid form and incorporated in the construction contract.

D. Overhead and Profit on Contract Changes shall be applied as follows:

1. The overhead and profit charge by the Contractor and all subcontractors shall be considered to include, but is not limited to: incidental job burdens, small truck (under 1 ton) expense, mileage, small hand tools, warranty costs, company benefits and general office overhead. Project supervision including field supervision and job site office expense shall be considered a part of overhead and profit unless a compensable time extension is granted.
2. The percentages for overhead and profit charged on Contract Changes shall be subject to the following limits: (a) the percentage mark-up for the Contractor shall be limited to the Contractor's fee; (b) fifteen percent (15%) maximum for Work directly performed by employees of a subcontractor, or sub-subcontractor; (c) five percent (5%) maximum for the Work performed or passed through to the Owner by the Contractor; (d) five percent (5%) maximum subcontractor's mark-up for Work performed by a sub-subcontractor and

passed through to the Owner by the subcontractor and Contractor; and (e) in no case shall the total overhead and profit paid by the Owner on any Contract Changes exceed twenty-five percent (25%) of the cost of materials, labor and equipment (exclusive of Contractor or any Subcontractor overhead and profit) necessary to put the contract change work in place.

3. The Contractor will be allowed to add the cost of Contractor's payment and performance bonding, builder's risk insurance, and general liability insurance to their cost of work. The above listed bonding and insurance cost shall not exceed 2% and shall be allowed on the total cost of the added work, including overhead and profit.
  4. On proposals covering both increases and decreases in the amount of this contract, the application of overhead and profit shall be on the net change in the cost of the work.
  5. The percentage(s) for overhead and profit to be credited to the Owner on Contract Changes that are solely decreases in the quantity of work or materials shall be the same as those for additive Contract Changes provided above.
- E. No claim for an addition to this contract sum shall be valid unless authorized as aforesaid in writing by the Owner. In the event that none of the foregoing methods are agreed upon, the Owner may order the Contractor to perform work on a time and material basis. The cost of such work shall be determined by the Contractor's actual labor and material cost to perform the work plus overhead and profit as outlined herein. The Designer and Construction Representative shall approve the Contractor's daily time and material invoices for the work involved.
- F. If the Contractor claims that any instructions involve extra cost under this contract, the Contractor shall give the Owner's Representative written notice thereof within a reasonable time after the receipt of such instructions, and in any event before proceeding to execute the work. No such claim shall be valid unless so made and authorized by the Owner, in writing.
- G. In an emergency affecting the safety of life or of the structure or of adjoining property, the Contractor, without special instruction or authorization from the Construction Representative, is hereby permitted to act at their discretion to prevent such threatened loss or injury. The Contractor shall submit a claim for

compensation for such emergency work in writing to the Owner's Representative.

#### **ARTICLE 4.2 – CHANGES IN COMPLETION TIME**

- A. Extension of the number of work days stipulated in the Contract for completion of the work with compensation may be made when:
  - 1. The contractor documents that proposed Changes in the work, as provided in Article 4.1, extends construction activities critical to contract completion date, OR
  - 2. The Owner suspends all work for convenience of the Owner as provided in Article 7.3, OR
  - 3. An Owner caused delay extends construction activities critical to contract completion (except as provided elsewhere in these General Conditions). The Contractor is to review the work activities yet to begin and evaluate the possibility of rescheduling the work to minimize the overall project delay.
- B. Extension of the number of work days stipulated in the Contract for completion of the work without compensation may be made when:
  - 1. Weather-related delays occur, subject to provisions for the inclusion of a specified number of "bad weather" days when provided for in Section 012100-Allowances, OR
  - 2. Labor strikes or acts of God occur, OR
  - 3. The work of the Contractor is delayed on account of conditions which were beyond the control of the Contractor, subcontractors or suppliers, and were not the result of their fault or negligence.
- C. No time extension or compensation will be provided for delays caused by or within the control of the Contractor, subcontractors or suppliers and for concurrent delays caused by the Owner.
- D. The Contractor shall notify the Owner promptly of any occurrence or conditions which in the Contractor's opinion results in a need for an extension of time. The notice shall be in writing and shall include all necessary supporting materials with details of any resultant costs and be submitted in time to permit full investigation and evaluation of the Contractor's claim. The Owner shall promptly acknowledge the Contractor's notice and, after recommendation from the Owner's Representative and/or Designer, shall provide a decision to the Contractor. Failure on the part of the Contractor to provide such notice and to detail the costs shall constitute a waiver by

the Contractor of any claim. Requests for extensions of time shall be for working days only.

#### **ARTICLE 5 - CONSTRUCTION AND COMPLETION**

##### **ARTICLE 5.1 – CONSTRUCTION COMMENCEMENT**

- A. Upon receipt of the "Intent to Award" letter, the Contractor must submit the following properly executed instruments to the Owner:
    - 1. Contract;
    - 2. Performance/payment bond as described in Article 6.1;
    - 3. Certificates of Insurance, or the actual policies themselves, showing that the Contractor has obtained the insurance coverage required by Article 6.2.
    - 4. Written Affirmative Action Plans as required in Article 1.4.
- Above referenced items must be received by the Owner within ten (10) working days after the effective date of the contract. If not received, the Owner may treat the failure to timely submit them as a refusal by the Contractor to accept a contract for this work and may retain as liquidated damages the Contractor's bid bond, cashier's check or certified check as provided in the Instructions to Bidders. Upon receipt the Owner will issue a "Notice to Proceed" with the work to the Contractor.
- B. Within the time frame noted in Section 013200 - Schedules, following receipt of the "Notice to Proceed", the Contractor shall submit to the Owner a progress schedule and schedule of values, showing activities through the end of the contract period. Should the Contractor not receive written notification from the Owner of the disapproval of the schedule of values within fifteen (15) working days, the Contractor may consider it approved for purpose of determining when the first monthly Application and Certification for Payment may be submitted.
  - C. The Contractor may commence work upon receipt of the Division of Facilities Management, Design and Construction's "Notice to Proceed" letter. Contractor shall prosecute the work with faithfulness and energy, and shall complete the entire work on or before the completion time stated in the contract documents or pay to the Owner the damages resulting from the failure to timely complete the work as set out within Article 5.4.

## ARTICLE 5.2 -- PROJECT CONSTRUCTION

- A. Each Contractor shall submit for the Owner's approval, in reproducible form, a progress schedule showing the rate of progress and the order of the work proposed to carry on various phases of the project. The schedule shall be in conformance with the requirements outlined in Section 013200 – Schedules.
- B. Contractor shall employ and supply a sufficient force of workers, material, and equipment and shall pay when due, any worker, subcontractor or supplier and otherwise prosecute the work with such diligence so as to maintain the rate of progress indicated on the progress schedule, prevent work stoppage, and insure completion of the project within the time specified.

## ARTICLE 5.3 -- PROJECT COMPLETION

- A. Substantial Completion. A Project is substantially complete when construction is essentially complete and work items remaining to be completed can be done without interfering with the Owner's ability to use the Project for its intended purpose.
  1. Once the Contractor has reached what they believe is Substantial Completion, the Contractor shall notify the Designer and the Construction Representative of the following:
    - a. That work is essentially complete with the exception of certain listed work items. The list shall be referred to as the "Contractor's Punch."
    - b. That all Operation and Maintenance Manuals have been assembled and submitted in accordance with Article 3.5A.
    - c. That the Work is ready for inspection by the Designer and Construction Representative. The Owner shall be entitled to a minimum of ten working days notice before the inspection shall be performed.
  2. If the work is acceptable, the Owner shall issue a Certificate of Substantial Completion, which shall set forth the responsibilities of the Owner and the Contractor for utilities, security, maintenance, damage to the work and risk of loss. The Certificate shall also identify those remaining items of work to be performed by the Contractor. All such work items shall be complete within 30 working days of the date of the Certificate, unless the Certificate specifies a different time. If the

Contractor shall be required to perform tests that must be delayed due to climatic conditions, it is understood that such tests and affected equipment will be identified on the Certificate and shall be accomplished by the Contractor at the earliest possible date. Performance of the tests may not be required before Substantial Completion can be issued. The date of the issuance of the Certificate of Substantial Completion shall determine whether or not the work was completed within the contract time and whether or not Liquidated Damages are due.

3. If the work is not acceptable, and the Owner does not issue a Certificate of Substantial Completion, the Owner shall be entitled to charge the Contractor with the Designer's and Owner's costs of re-inspection, including time and travel.
- B. Partial Occupancy. Contractor agrees that the Owner shall be permitted to occupy and use any completed or partially completed portions of the Project, when such occupancy and use is in the Owner's best interest. Owner shall notify Contractor of its desire and intention to take Partial Occupancy as soon as possible but at least ten (10) working days before the Owner intends to occupy. If the Contractor believes that the portion of the work the Owner intends to occupy is not ready for occupancy, the Contractor shall notify the Owner immediately. The Designer shall inspect the work in accordance with the procedures above. If the Contractor claims increased cost of the project or delay in completion as a result of the occupancy, he shall notify the Owner immediately but in all cases before occupancy occurs.
- C. Final Completion. The Project is finally complete when the Certificate of Substantial Completion has been issued and all work items identified therein as incomplete have been completed, and when all administrative items required by the contract have been completed. Final Completion entitles the Contractor to payment of the outstanding balance of the contract amount including all change orders and retainage. Within five (5) working days of the date of the Certificate of Substantial Completion, the Contractor shall identify the cost to complete any outstanding items of work. The Designer shall review the Contractor's estimate and either approve it or provide an independent estimate for all such items. If the Contractor fails to complete the remaining items within the time specified in the Certificate, the Owner may terminate the contract and go to the surety for project completion in accordance with Article 7.2 or release the contract balance to the Contractor less 150% of the

approved estimate to complete the outstanding items. Upon completion of the outstanding items, when a final cost has been established, any monies remaining shall be paid to the Contractor. Failure to complete items of work does not relieve the Contractor from the obligation to complete the administrative requirements of the contract, such as the provisions of Article 5.3 FAILURE TO COMPLETE ALL ITEMS OF WORK UNDER THE CONTRACT SHALL BE CONSIDERED A DEFAULT AND BE GROUNDS FOR CONTRACT TERMINATION AND DEBARMENT.

- D. Liquidated Damages. Contractor agrees that the Owner may deduct from the contract price and retain as liquidated damages, and not as penalty or forfeiture, the sum stipulated in this contract for each work day after the Contract Completion Day on which work is not Substantially Complete. Assessment of Liquidated Damages shall not relieve the Contractor or the surety of any responsibility or obligation under the Contract. In addition, the Owner may, without prejudice to any other rights, claims, or remedies the Owner may have including the right to Liquidated Damages, charge the Contractor for all additional expenses incurred by the Owner and/or Designer as the result of the extended contract period through Final Completion. Additional Expenses shall include but not be limited to the costs of additional inspections.
- E. Early Completion. The Contractor has the right to finish the work before the contract completion date; however, the Owner assumes no liability for any hindrances to the Contractor unless Owner caused delays result in a time extension to the contract completion date. The Contractor shall not be entitled to any claims for lost efficiencies or for delay if a Certificate of Substantial Completion is given on or before the Contract Completion Date.

#### **ARTICLE 5.4 -- PAYMENT TO CONTRACTOR**

- A. Payments on account of this contract will be made monthly in proportion to the work which has been completed. Request for payment must be submitted on the Owner's forms. No other pay request will be processed. Supporting breakdowns must be in the same format as Owner's forms and must provide the same level of detail. The Designer will, within 5 working days from receipt of the contractor's request for payment either issue a Certificate for Payment to the Owner, for such amount as the Designer determines is properly due, or notify the Contractor in writing of reasons for withholding a Certificate. The Owner shall make payment within 30 calendar days after the

"Application and Certification for Payment" has been received and certified by the Designer. The following items are to be attached to the contractor's pay request:

1. Updated construction schedule
  2. Certified payrolls consisting of name, occupation and craft, number of hours worked and actual wages paid for each individual employee, of the Contractor and all subcontractors working on the project
- B. The Owner shall retain 5 percent of the amount of each such payment application, except as allowed by Article 5.4, until final completion and acceptance of all work covered by this contract.
- C. Each payment made to Contractor shall be on account of the total amount payable to Contractor and all material and work covered by paid partial payment shall thereupon become the sole property of Owner. This provision shall not be construed as relieving Contractor from sole responsibility for care and protection of materials and work upon which payments have been made or restoration of any damaged work or as a waiver of the right of Owner to require fulfillment of all terms of this contract.
- D. Materials delivered to the work site and not incorporated in the work will be allowed in the Application and Certification for Payment on the basis of one hundred (100%) percent of value, subject to the 5% retainage providing that they are suitably stored on the site or in an approved warehouse in accordance with the following requirements:
1. Material has previously been approved through submittal and acceptance of shop drawings conforming to requirements of Article 3.2 of General Conditions.
  2. Delivery is made in accordance with the time frame on the approved schedule.
  3. Materials, equipment, etc., are properly stored and protected from damage and deterioration and remain so - if not, previously approved amounts will be deleted from subsequent pay applications.
  4. The payment request is accompanied by a breakdown identifying the material equipment, etc. in sufficient detail to establish quantity and value.
- E. The Contractor shall be allowed to include in the Application and Certification for Payment, one hundred (100%) of the value, subject to retainage,

of major equipment and material stored off the site if all of the following conditions are met:

1. The request for consideration of payment for materials stored off site is made at least 15 working days prior to submittal of the Application for Payment including such material. Only materials inspected will be considered for inclusion on Application for Payment requests.
  2. Materials stored in one location off site are valued in excess of \$25,000.
  3. That a Certificate of Insurance is provided indicating adequate protection from loss, theft conversion or damage for materials stored off site. This Certificate shall show the State of Missouri as an additional insured for this loss.
  4. The materials are stored in a facility approved and inspected, by the Construction Representative.
  5. Contractor shall be responsible for, Owner costs to inspect out of state facilities, and any delays in the completion of the work caused by damage to the material or for any other failure of the Contractor to have access to this material for the execution of the work.
- F. The Owner shall determine the amount, quality and acceptability of the work and materials which are to be paid for under this contract. In the event any questions shall arise between the parties, relative to this contract or specifications, determination or decision of the Owner or the Construction Representative and the Designer shall be a condition precedent to the right of the Contractor to receive any money or payment for work under this contract affected in any manner or to any extent by such question.
- G. Payments Withheld: The Owner may withhold or nullify in whole or part any certificate to such extent as may be necessary to protect the Owner from loss on account of:
1. Defective work not remedied. When a notice of noncompliance is issued on an item or items, corrective action shall be undertaken immediately. Until corrective action is completed, no monies will be paid and no additional time will be allowed for the item or items. The cost of corrective action(s) shall be borne by the Contractor.
  2. A reasonable doubt that this contract can be completed for the unpaid balance.
3. Failure of the Contractor to update as-built drawings monthly for review by the Construction Representative.
  4. Failure of the Contractor to update the construction schedule.
- When the Construction Representative is satisfied the Contractor has remedied above deficiencies, payment shall be released.
- H. Final Payment: Upon receipt of written notice from the Contractor to the Designer and Project Representative that the work is ready for final inspection and acceptance, the Designer and Project Representative, with the Contractor, shall promptly make such inspection. If the work is acceptable and the contract fully performed, the Construction Representative shall complete a final acceptance report and the Contractor will be directed to submit a final Application and Certification for Payment. If the Owner approves the same, the entire balance shall be due and payable, with the exception of deductions as provided for under Article 5.4.
1. Where the specifications provide for the performance by the Contractor of (certain tests for the purpose of balancing and checking the air conditioning and heating equipment and the Contractor shall have furnished and installed all such equipment in accordance with the specifications, but said test cannot then be made because of climatic conditions, such test shall may be considered as required under the provisions of the specifications, Section 013300 and this contract may be substantial Full payment will not be made until the tests have been made and the equipment and system is finally accepted. If the tests are not completed when scheduled, the Owner may deduct 150% of the value of the tests from the final payment.
  2. The final payment shall not become due until the Contractor delivers to the Construction Representative:
    - a) A complete file of releases, on the standard form included in the contract documents as "Final Receipt of Payment and Release Form", from subcontractors and material suppliers evidencing payment in full for services, equipment and materials, as the case may require, if the Owner approves, or a consent from the Surety to final payment accepting liability for any unpaid amounts.

- b) An Affidavit of Compliance with Prevailing Wage Law, in the form as included in this contract specifications, properly executed by each subcontractor, and the Contractor
  - c) Certified copies of all payrolls
  - d) As-built drawings
3. If any claim remains unsatisfied after all payments are made, the Contractor shall refund to the Owner all monies that the latter may be compelled to pay in discharging such a claim including all costs and a reasonable attorney's fee.
  4. Missouri statute requires prompt payment from the Owner to the Contractor within thirty calendar days and from the Contractor to his subcontractors within fifteen calendar days. Failure to make payments within the required time frame entitles the receiving party to charge interest at the rate of one and one half percent per month calculated from the expiration of the statutory time period until paid.
  5. The value of all unused unit price allowances and/or 150% of the value of the outstanding work items, and/or liquidated damages may be deducted from the final pay request without executing a Contract Change. Any unit price items which exceed the number of units in the contract may be added by Contract Change.

**ARTICLE 6 -- INSURANCE AND BONDS**

**ARTICLE 6.1 -- BOND**

- A. Contractor shall furnish a performance/payment bond in an amount equal to 100% of the contract price to guarantee faithful performance of the contract and 100% of the contract price to guarantee the payment of all persons performing labor on the project and furnishing materials in connection therewith under this contract as set forth in the standard form of performance and payment bond included in the contract documents. The surety on such bond shall be issued by a surety company authorized by the Missouri Department of Insurance to do business in the state of Missouri.
- B. All Performance/Payment Bonds furnished in response to this provision shall be provided by a bonding company with a rating of B+ or higher as established by A.M. Best Company, Inc. in their most recent publication.

**ARTICLE 6.2 – INSURANCE**

- A. The successful Contractor shall procure and maintain for the duration of the contract issued a policy or policies of insurance for the protection of both the Contractor and the Owner and their respective officers, officials, agents, consultants and employees. The Owner requires certification of insurance coverage from the Contractor prior to commencing work.
- B. Minimum Scope and Extent of Coverage
  1. General Liability
 

Commercial General Liability, ISO coverage form number or equivalent CG 00 01 ("occurrence" basis), or I-SO coverage form number CG 00 02, or ISO equivalent.

If ISO equivalent or manuscript general liability coverage forms are used, minimum coverage will be as follows: Premises/Operations; Independent Contractors; Products/Completed Operations; personal Injury; Broad Form Property Damage including Completed Operations; Broad Form Contractual Liability Coverage to include Contractor's obligations under Article 1.11 Indemnification and any other Special Hazards required by the work of the contract.
  2. Automobile Liability
 

Business Automobile Liability Insurance, ISO Coverage form number or equivalent CA 00 01 covering automobile liability, code 1 "ANY AUTO".
  3. Workers' Compensation and Employer's Liability
 

Statutory Workers' Compensation Insurance for Missouri and standard Employer's Liability Insurance, or the authorization to self-insure for such liability from the Missouri Division of Workers' Compensation.
  4. Builder's Risk or Installation Floater Insurance
 

Insurance upon the work and all materials, equipment, supplies, temporary structures and similar items which may be incident to the performance of the work and located at or adjacent to the site, against loss or damage from fire and such other casualties as are included in extended coverage in broad "All Risk" form, including coverage for Flood and Earthquake, in an amount not less than the replacement cost of the work or this contract price, whichever is greater, with loss payable



to Contractor and Owner as their respective interests may appear.

Contractor shall maintain sufficient insurance to cover the full value of the work and materials as the work progresses, and shall furnish Owner copies of all endorsements. If Builder's Risk Reporting- Form of Endorsement is used, Contractor shall make all reports as required therein so as to keep in force an amount of insurance which will equal the replacement cost of the work, materials, equipment, supplies, temporary structures, and other property covered thereby; and if, as a result of Contractor's failure to make any such report, the amount of insurance so recoverable shall be less than such replacement cost, Contractor's interest in the proceeds of such insurance, if any, shall be subordinated to Owner's interest to the end that Owner may receive full reimbursement for its loss.

C. Minimum Limits of Insurance

1. General Liability

Contractor

\$2,000,000 combined single limit per occurrence for bodily injury, personal injury, and property damage

\$2,000,000 annual aggregate

2. Automobile Liability

\$2,000,000 combined single limit per occurrence for bodily injury and property damage

3. Workers' Compensation and Employers Liability

Workers' Compensation limits as required by applicable State Statutes (generally unlimited) and minimum of \$1,000,000 limit per accident for Employer's Liability.

General Liability and Automobile Liability insurance may be arranged under individual policies for the full limits required or by a combination of underlying policies with the balance provided by a form-following Excess or Umbrella Liability policy.

D. Deductibles and Self-Insured Retentions

All deductibles, co-payment clauses, and self-insured retentions must be declared to and approved by the Owner. The Owner reserves the right to request the reduction or elimination of unacceptable deductibles or self-insured retentions,

as they would apply to the Owner, and their respective officers, officials, agents, consultants and employees. Alternatively, the Owner may request Contractor to procure a bond guaranteeing payment of losses and related investigations, claims administration, and defense expenses.

E. Other Insurance Provisions and Requirements

The respective insurance policies and coverage, as specified below, must contain, or be endorsed to contain the following conditions or provisions:

1. General Liability

The Owner, and its respective commissioners, officers, officials, agents, consultants and employees shall be endorsed as additional insured's by ISO form CG 20 26 Additional Insured - Designated Person or Organization. As additional insured's, they shall be covered as to work performed by or on behalf of the Contractor or as to liability which arises out of Contractor's activities or resulting from the performance of services or the delivery of goods called for by the Contract.

Contractor's insurance coverage shall be primary with respect to all additional insured's. Insurance of self-insurance programs maintained by the designated additional -insured's shall be excess of the Contractor's insurance and shall not contribute with it.

Additionally, the Contractor and Contractor's general liability insurer shall agree to waive all rights of subrogation against the Owner and any of their respective officers, officials, agents, consultants or employees for claims, losses, or expenses which arise out of Contractor's activities or result from the performance of services or the delivery of goods called for by the Contract.

Contractor's failure to comply with the terms and conditions of these insurance policies shall not affect or abridge coverage for the Owner, or for any of their officers, officials, agents, consultants or employees.

2. Automobile Insurance

The Owner, and their respective officers, officials, agents, consultants and employees shall be endorsed as additional insured's by ISO form CG 20 26 - Additional Insured Designated Person or Organization. As additional insured's, they shall be covered as to work performed by or on behalf of the Contractor or as to liability which arises out of Contractor's activities or resulting from the

performance of services or the delivery of goods called for by the Contract.

Contractor's insurance coverage shall be primary with respect to all additional insured's. Insurance or self-insurance programs maintained by the designated additional insured's shall be in excess of the Contractor's insurance and shall not contribute with it.

Additionally, the Contractor and Contractor's automobile insurer shall agree to waive all rights of subrogation against the Owner and any of their respective officers, officials, agents, consultants or employees for claims, losses, or expenses which arise out of Contractor's activities or result from the performance of services or the delivery of goods called for by the Contract.

Contractor's failure to comply with the terms and conditions of these insurance policies shall not affect or abridge coverage for the Owner or for any of its officers, officials, agents, consultants or employees.

3. Workers' Compensation/Employer's Liability

Contractor's workers' compensation insurance shall be endorsed with NCCI form WC 00 03 01 A - Alternative Employer Endorsement. The Alternative Employer Endorsement shall designate the Owner as "alternate employers."

4. All Coverages

Each insurance policy required by this section of the Contract shall contain a stipulation, endorsed if necessary, that the Owner will receive a minimum of a thirty (30) calendar day advance notice of any policy cancellation. Ten (10) calendar days advance notice is required for policy cancellation due to non-payment of premium.

F. Insurer Qualifications and Acceptability

Insurance required hereunder shall be issued by an A.M. Best, "B+" rated, Class IX insurance company approved to conduct insurance business in the state of Missouri.

G. Verification of Insurance Coverage

Prior to Owner issuing a Notice to Proceed, the Contractor shall furnish the Owner with Certificate(s) of Insurance and with any applicable original endorsements evidencing the required insurance coverage. The insurance certificates and endorsements are to be signed by a person authorized by that insurer to bind coverage on its

behalf. All certificates and endorsements received by the Owner are subject to review and approval by the Owner. The Owner reserves the right to require certified copies of all required policies at any time. If the scope of this contract will exceed one (1) year - or, if any of Contractor's applicable insurance coverage expires prior to completion of the work or services required under this contract - the Contractor will provide a renewal or replacement certificate before continuing work or services hereunder. If the Contractor fails to provide documentation of required insurance coverage, the Owner may issue a stop work order and no additional contract completion time and/or compensation shall be granted as a result thereof.

**ARTICLE 7 – SUSPENSION OR TERMINATION OF CONTRACT**

**ARTICLE 7.1 - FOR SITE CONDITIONS**

When conditions at the site of the proposed work are considered by the Owner to be unsatisfactory for prosecution of the work, the Contractor may be ordered in writing to suspend the work or any part thereof until reasonable conditions exist. When such suspension is not due to fault or negligence of the Contractor, time allowed for completion of such suspended work will be extended by a period of time equal to that lost due to delay occasioned by ordered suspension. This will be a no cost time extension.

**ARTICLE 7.2 - FOR CAUSE**

A. Termination or Suspension for Cause:

1. If the Contractor shall file for bankruptcy, or should make a general assignment for the benefit of the creditors, or if a receiver should be appointed on account of insolvency, or if the contractor should persistently or repeatedly refuse or fail to supply enough properly skilled workers or proper materials, or if the contractor should fail to make prompt payment to subcontractors or for material or labor, or persistently disregard laws, ordinances or the instructions of the Owner, or otherwise be guilty of a substantial violation of any provision of this contract, then the Owner may serve notice on the Contractor and the surety setting forth the violations and demanding compliance with this contract. Unless within ten (10) consecutive calendar days after serving such notice, such violations shall cease and satisfactory arrangements for correction be made, the Owner may suspend the Contractor's right to proceed with the work or terminate this contract.

2. In the event the Owner suspends Contractor's right to proceed with the work or terminates the contract, the Owner may demand that the Contractor's surety take over and complete the work on this contract, after the surety submits a written proposal to the Owner and receives written approval and upon the surety's failure or refusal to do so within ten (10) consecutive calendar days after demand therefore, the Owner may take over the work and prosecute the same to completion by bid or negotiated contract, or the Owner may elect to take possession of and utilize in completing the work such materials, supplies, appliances and plant as may be on the site of the work, and all subcontractors, if the Owner elects, shall be bound to perform their contracts.
- B. The Contractor and its surety shall be and remain liable to the Owner for any excess cost or damages occasioned to the Owner as a result of the actions above set forth.
- C. The Contractor in the event of such suspension or termination shall not be entitled to receive any further payments under this contract until the work is wholly finished. Then if the unpaid balance under this contract shall exceed all expenses of the Owner as certified by the Director, such excess shall be paid to the Contractor; but, if such expenses shall exceed the unpaid balance as certified by the Director, the Contractor and their surety shall be liable for and shall pay the difference and any damages to the Owner.
- D. In exercising Owner's right to secure completion of the work under any of the provisions hereof, the Director shall have the right to exercise Owner's sole discretion as to the manner, methods and reasonableness of costs of completing the work.
- E. The rights of the Owner to suspend or terminate as herein provided shall be cumulative and not exclusive and shall be in addition to any other remedy provided by law.
- F. The Contractor in the event of such suspension or termination may be declared ineligible for Owner contracts for a minimal period of twelve (12) months. Further, no contract will be awarded to any Contractor who lists in their bid form any subcontractor whose prior performance has contributed, as determined by the Owner, to a breach of a contract. In order to be considered for state-awarded contracts after this period, the Contractor/subcontractor will be required to forward acceptance reports to the Owner regarding successful completion of non-state projects during the intervening twelve (12) months from the date

of default. No contracts will be awarded to a subcontractor/Contractor until the ability to perform responsibly in the private sector has been proven to the Owner.

#### **ARTICLE 7.3 -- FOR CONVENIENCE**

- A. The Owner may terminate or suspend the Contract or any portion of the Work without cause at any time, and at the Owner's convenience. Notification of a termination or suspension shall be in writing and shall be given to the Contractor and their surety. If the Contract is suspended, the notice will contain the anticipated duration of the suspension or the conditions under which work will be permitted to resume. If appropriate, the Contractor will be requested to demobilize and re-mobilize and will be reimbursed time and costs associated with the suspension.
- B. Upon receipt of notification, the Contractor shall:
  1. Cease operations when directed.
  2. Take actions to protect the work and any stored materials.
  3. Place no further subcontracts or orders for material, supplies, services or facilities except as may be necessary to complete the portion of the Contract that has not been terminated. No claim for payment of materials or supplies ordered after the termination date shall be considered.
  4. Terminate all existing subcontracts, rentals, material, and equipment orders.
  5. Settle all outstanding liabilities arising from termination with subcontractors and suppliers.
  6. Transfer title and deliver to the Owner, work in progress, completed work, supplies and other material produced or acquire for the work terminated, and completed or partially completed plans, drawings information and other property that, if the Contract had been completed, would be required to be furnished to the Owner.
- C. For termination without cause and at the Owner's convenience, in addition to payment for work completed prior to date of termination, the Contractor may be entitled to payment of other documented costs directly associated with the early termination of the contract. Payment for anticipated profit and unapplied overhead will not be allowed.

## SECTION 007300 - SUPPLEMENTARY CONDITIONS

### 1.0 GENERAL:

A. These Supplementary General Conditions clarify, add, delete, or otherwise modify standard terms and conditions of DIVISION 0, BIDDING AND CONTRACTING REQUIREMENTS.

### 2.0 CONTACTS:

Designer: Eric Poettker  
McClure Engineering  
1000 Clark Ave.  
St. Louis, MO 63102  
Telephone: 314-645-6232  
Email: [EPoettker@mcclureeng.com](mailto:EPoettker@mcclureeng.com)

Construction Representative: Randy Duncan  
Division of Facilities Management, Design and Construction  
709 Missouri Blvd (Upper Level)  
Jefferson City, MO 65109  
Telephone: 573-526-0582  
Email: [randy.duncan@oa.mo.gov](mailto:randy.duncan@oa.mo.gov)

Project Manager: Christopher Lloyd  
Division of Facilities Management, Design and Construction  
301 West High Street, Room 730  
Jefferson City, Missouri 65101  
Telephone: 573-526-0160  
Email: Christopher. [Lloyd@oa.mo.gov](mailto:Lloyd@oa.mo.gov)

Contract Specialist: April Howser  
Division of Facilities Management, Design and Construction  
301 West High Street, Room 730  
Jefferson City, Missouri 65101  
Telephone: 573-751-0053  
Email: [april.howser@oa.mo.gov](mailto:april.howser@oa.mo.gov)

### 3.0 NOTICE: ALL BID MATERIALS ARE DUE AT THE TIME OF BID SUBMITTAL. THERE IS NO SECOND SUBMITTAL FOR THIS PROJECT.

### 4.0 FURNISHING CONSTRUCTION DOCUMENTS:

- A. The Owner will furnish the Contractor with approximately 5 complete sets of drawings and specifications at no charge.
- B. The Owner will furnish the Contractor with approximately 5 sets of explanatory or change drawings at no charge.
- C. The Contractor may make copies of the documents as needed with no additional cost to the Owner.

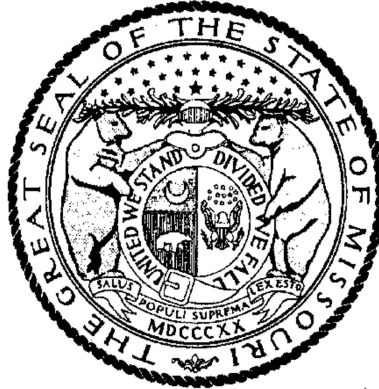
### 5.0 SAFETY REQUIREMENTS

Contractor and subcontractors at any tier shall comply with RSMo 292.675 and Article 1.3, E, of Section 007213, General Conditions.

# Missouri

## Division of Labor Standards

### WAGE AND HOUR SECTION



MICHAEL L. PARSON, Governor

# Annual Wage Order No. 30

Section 046  
**HOWELL COUNTY**

In accordance with Section 290.262 RSMo 2000, within thirty (30) days after a certified copy of this Annual Wage Order has been filed with the Secretary of State as indicated below, any person who may be affected by this Annual Wage Order may object by filing an objection in triplicate with the Labor and Industrial Relations Commission, P.O. Box 599, Jefferson City, MO 65102-0599. Such objections must set forth in writing the specific grounds of objection. Each objection shall certify that a copy has been furnished to the Division of Labor Standards, P.O. Box 449, Jefferson City, MO 65102-0449 pursuant to 8 CSR 20-5.010(1). A certified copy of the Annual Wage Order has been filed with the Secretary of State of Missouri.

Original Signed by \_\_\_\_\_

Todd Smith, Director  
Division of Labor Standards

Filed With Secretary of State: \_\_\_\_\_ **March 10, 2023**

Last Date Objections May Be Filed: **April 10, 2023**

Prepared by Missouri Department of Labor and Industrial Relations

OCCUPATIONAL TITLE	**Prevailing Hourly Rate
Asbestos Worker	\$23.65*
Boilermaker	\$23.65*
Bricklayer	\$49.49
Carpenter	\$23.65*
Lather	
Linoleum Layer	
Millwright	
Pile Driver	
Cement Mason	\$23.65*
Plasterer	
Communications Technician	\$23.65*
Electrician (Inside Wireman)	\$46.05
Electrician Outside Lineman	\$23.65*
Lineman Operator	
Lineman - Tree Trimmer	
Groundman	
Groundman - Tree Trimmer	
Elevator Constructor	\$23.65*
Glazier	\$23.65*
Ironworker	\$23.65*
Laborer	\$39.23
General Laborer	
First Semi-Skilled	
Second Semi-Skilled	
Mason	\$23.65*
Marble Mason	
Marble Finisher	
Terrazzo Worker	
Terrazzo Finisher	
Tile Setter	
Tile Finisher	
Operating Engineer	\$23.65*
Group I	
Group II	
Group III	
Group III-A	
Group IV	
Group V	
Painter	\$23.65*
Plumber	\$61.03
Pipe Fitter	
Roofer	\$23.65*
Sheet Metal Worker	\$23.65*
Sprinkler Fitter	\$23.65*
Truck Driver	\$23.65*
Truck Control Service Driver	
Group I	
Group II	
Group III	
Group IV	

\*The Division of Labor Standards received fewer than 1,000 reportable hours for this occupational title. The public works contracting minimum wage is established for this occupational title using data provided by Missouri Economic Research and Information Center.

\*\*The Prevailing Hourly Rate includes any applicable fringe benefit amounts for each occupational title as defined in RSMO Section 290.210.

Heavy Construction Rates for  
HOWELL County

Section 046

OCCUPATIONAL TITLE	**Prevailing Hourly Rate
Carpenter	\$23.65*
Millwright	
Pile Driver	
Electrician (Outside Lineman)	\$23.65*
Lineman Operator	
Lineman - Tree Trimmer	
Groundman	
Groundman - Tree Trimmer	
Laborer	\$46.55
General Laborer	
Skilled Laborer	
Operating Engineer	\$60.33
Group I	
Group II	
Group III	
Group IV	
Truck Driver	\$23.65*
Truck Control Service Driver	
Group I	
Group II	
Group III	
Group IV	

Use Heavy Construction Rates on Highway and Heavy construction in accordance with the classifications of construction work established in 8 CSR 30-3.040(3).

Use Building Construction Rates on Building construction in accordance with the classifications of construction work established in 8 CSR 30-3.040(2).

If a worker is performing work on a heavy construction project within an occupational title that is not listed on the Heavy Construction Rate Sheet, use the rate for that occupational title as shown on the Building Construction Rate Sheet.

\*The Division of Labor Standards received fewer than 1,000 reportable hours for this occupational title. Public works contracting minimum wage is established for this occupational title using data provided by Missouri Economic Research and Information Center.

\*\*The Prevailing Hourly Rate includes any applicable fringe benefit amounts for each occupational title.

# OVERTIME and HOLIDAYS

## OVERTIME

For all work performed on a Sunday or a holiday, not less than twice (2x) the prevailing hourly rate of wages for work of a similar character in the locality in which the work is performed or the public works contracting minimum wage, whichever is applicable, shall be paid to all workers employed by or on behalf of any public body engaged in the construction of public works, exclusive of maintenance work.

For all overtime work performed, not less than one and one-half (1½) the prevailing hourly rate of wages for work of a similar character in the locality in which the work is performed or the public works contracting minimum wage, whichever is applicable, shall be paid to all workers employed by or on behalf of any public body engaged in the construction of public works, exclusive of maintenance work or contractual obligation. For purposes of this subdivision, "**overtime work**" shall include work that exceeds ten hours in one day and work in excess of forty hours in one calendar week; and

A thirty-minute lunch period on each calendar day shall be allowed for each worker on a public works project, provided that such time shall not be considered as time worked.

## HOLIDAYS

January first;  
The last Monday in May;  
July fourth;  
The first Monday in September;  
November eleventh;  
The fourth Thursday in November; and  
December twenty-fifth;

If any holiday falls on a Sunday, the following Monday shall be considered a holiday.



## SECTION 011000 – SUMMARY OF WORK

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract including General and Supplementary Conditions and Division 1 Specification Sections apply to this Section.

#### 1.2 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Project consists of complete demolition and replacement of (2) existing HVAC units with (3) new roof mounted units, installation of VAV boxes with electric reheat in existing multizone duct, and air devices. Additional scope includes supporting structural and electrical work.
  - 1. Project Location: 1226 W. Business US-60/63  
Willow Springs, MO 65793
  - 2. Owner: Missouri State Highway Patrol
- B. Contract Documents, dated 1/25/24 were prepared for the Project by **McClure Engineering** – 1000 Clark Ave. St. Louis, Mo 63102
- C. The Work consists of demolishing existing HVAC system. New work includes new HVAC units, and supporting electrical and structural scope.
- D. The Work will be constructed under a single prime contract.

#### 1.3 WORK SEQUENCE

- A. The Work will be conducted in 3 phases.
  - 1. Phase 1 is the modifications to ground floor ductwork. This work includes but is not limited to installation of VAV's, and all associated controls, electrical and architectural work.
  - 2. Phase 2 includes the replacement of RTU-1, installation of DOAS-1, and all associated ductwork modifications for the above systems. This work includes but is not limited to replacement of RTU, installation of VAV's, and all associated controls, electrical and architectural work.
  - 3. Phase 3 includes replacement of RTU-2 and all associated ductwork modifications. This work includes but is not limited to replacement of the RTU installation of VAV's, ceiling tiles and all associated electrical, structural, and architectural work.

#### 1.4 CONTRACTOR USE OF PREMISES

- A. General: During the construction period the Contractor shall have full use of the premises for construction operations, including use of the site. The Contractor's use of the premises limited only by the Owner's right to perform work or to retain other contractors on portions of the Project.

- B. Use of the Site: Limit use of the premises to work in areas indicated. Confine operations to areas within contract limits indicated. Do not disturb portions of the site beyond the areas in which the Work is indicated.
  - 1. Owner Occupancy: Allow for Owner occupancy and use by the public.
  - 2. Driveways and Entrances: Keep driveways and entrances serving the premises clear and available to the Owner, the Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- C. Use of the Existing Building: Maintain the existing building in a weathertight condition throughout the construction period. Repair damage cause by construction operations. Take all precautions necessary to protect the building and its occupants during the construction period.

## **1.5 OCCUPANCY REQUIREMENTS**

- A. Full Owner Occupancy: The Owner will occupy the site and existing building during the entire construction period. Cooperate with the Owner during construction operations to minimize conflicts and facilitate owner usage. Perform the Work so as not to interfere with the Owner's operations.

**END OF SECTION 011000**

## **SECTION 012100 – ALLOWANCES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract including General and Supplementary Conditions and other Division 1 Specification Sections apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes administrative and procedural requirements governing allowances.
  - 1. Certain items are specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when additional information is available for evaluation. If necessary, additional requirements will be issued by Change Order.
- B. Types of allowances include the following:
  - 1. Lump-sum allowances.
  - 2. Weather allowances.
- C. Related Sections include the following:
  - 1. Division 1 Section "Contract Modification Procedures" for procedures for submitting and handling Change Orders for allowances.
  - 2. Division 1 Section "Unit Prices" for procedures for using unit prices.

#### **1.3 WEATHER ALLOWANCE**

- A. Included within the completion period for this project are a specified number of “bad weather” days (see Schedule of Allowances).
- B. The Contractor’s progress schedule shall clearly indicate the bad weather day allowance as an “activity” or “activities”. In the event weather conditions preclude performance of critical work activities for 50% or more of the Contractor’s scheduled workday, that day shall be declared unavailable for work due to weather (a “bad weather” day) and charged against the above allowance. Critical work activities will be determined by review of the Contractor’s current progress schedule.
- C. The Contractor’s Representative and the Construction Representative shall agree monthly on the number of “bad weather” days to be charged against the allowance. This determination will be documented in writing and be signed by the Contractor and the Construction Representatives. If there is a failure to agree on all or part of the “bad weather” days for a particular month, that disagreement shall be noted on this written document and signed by each party’s representative. Failure of the Contractor’s representative to sign the “bad weather” day documentation after it is presented, with or without the notes of disagreement, shall constitute agreement with the “bad weather” day determination contained in that document.
- D. There will be no modification to the time of contract performance due solely to the failure to deplete the “bad weather” day allowance.

- E. Once this allowance is depleted, a no cost Change Order time extension will be executed for “bad weather” days, as defined above, encountered during the remainder of the Project.

#### **1.4 SELECTION AND PURCHASE**

- A. At the earliest practical date after award of the Contract, Designer of the date when final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the Work.
- B. At Designer's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.
- C. Purchase products and systems selected by Designer from the designated supplier.

#### **1.5 SUBMITTALS**

- A. Submit proposals for purchase of products or systems included in allowances, in the form specified for Change Orders.
- B. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.
- C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

#### **1.6 COORDINATION**

- A. Coordinate allowance items with other portions of the Work. Furnish templates as required to coordinate installation.

#### **1.7 [LUMP-SUM] ALLOWANCES**

- A. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials under allowance shall be included as part of the Contract Sum and not part of the allowance.

### **PART 2 - PRODUCTS (Not Used)**

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

#### **3.2 PREPARATION**

- A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

### **3.3 SCHEDULE OF ALLOWANCES**

- A. Weather Allowance: Included within the completion period for this Project 5“bad weather” days.

**END OF SECTION 012100**

## **SECTION 012600 – CONTRACT MODIFICATION PROCEDURES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract including General and Supplementary Conditions and other Division 1 Specification Sections apply to this Section.

#### **1.2 SUMMARY**

- A. This Section specifies administrative and procedural requirements for handling and processing Contract Modifications.
- B. Related Sections include the following:
  - 1. Division 1, Section 012100 "Allowances" for procedural requirements for handling and processing Allowances.
  - 2. Division 1, Section 013115 "Project Management Communications" for administrative requirements for communications.
  - 3. Division 0, Section 007213, Article 3.1 "Acceptable Substitutions" for administrative procedures for handling Requests for Substitutions made after Contract award.
  - 4. Division 0, Section 007213, Article 4.0 "Changes in the Work" for Change Order requirements.

#### **1.3 REQUESTS FOR INFORMATION**

- A. In the event that the Contractor or Subcontractor, at any tier, determines that some portion of the Drawings, Specifications, or other Contract Documents requires clarification or interpretation, the Contractor shall submit a "Request for Information" (RFI) in writing to the Designer. A RFI may only be submitted by the Contractor and shall only be submitted on the RFI forms provided by the Owner. The Contractor shall clearly and concisely set forth the issue for which clarification or interpretation is sought and why a response is needed. In the RFI, the Contractor shall set forth an interpretation or understanding of the requirement along with reasons why such an understanding was reached.
- B. Responses to RFI shall be issued within ten (10) working days of receipt of the Request from the Contractor unless the Designer determines that a longer time is necessary to provide an adequate response. If a longer time is determined necessary by the Designer, the Designer will, within five (5) working days of receipt of the request, notify the Contractor of the anticipated response time. If the Contractor submits a RFI on a time sensitive activity on the current project schedule, the Contractor shall not be entitled to any time extension due to the time it takes the Designer to respond to the request provided that the Designer responds within the ten (10) working days set forth above.
- C. Responses from the Designer will not change any requirement of the Contract Documents. In the event the Contractor believes that a response to a RFI will cause a change to the requirements of the Contract Document, the Contractor shall give written

notice to the Designer requesting a Change Order for the work. Failure to give such written notice within ten (10) working days, shall waive the Contractor's right to seek additional time or cost under Article 4, "Changes in the Work" of the General Conditions.

#### **1.4 MINOR CHANGES IN THE WORK**

- A. Designer will issue supplemental instructions authorizing Minor Changes in the Work, not involving adjustment to the Contract Amount or the Contract Time, on "Designer's Supplemental Instructions" (DSI).

#### **1.5 PROPOSAL REQUESTS**

- A. The Designer or Owner Representative will issue a detailed description of proposed Changes in the Work that may require adjustment to the Contract Amount or the Contract Time. The proposed Change Description will be issued using the "Request for Proposal" (RFP) form. If necessary, the description will include supplemental or revised Drawings and Specifications.
  - 1. Proposal Requests issued by the Designer or Owner Representative are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.
  - 2. Within ten (10) working days after receipt of Proposal Request, submit a proposal for the cost adjustments to the Contract Amount and the Contract Time necessary to execute the Change. The Contractor shall submit his proposal on the appropriate Change Order Detailed Breakdown form. Subcontractors may use the appropriate Change Order Detailed Breakdown form or submit their proposal on their letterhead provided the same level of detail is included. All proposals shall include:
    - a. A detailed breakdown of costs per Article 4.1 of the General Conditions.
    - b. If requesting additional time per Article 4.2 of the General Conditions, include an updated Contractor's Construction Schedule that indicates the effect of the Change including, but not limited to, changes in activity duration, start and finish times, and activity relationship.

#### **1.6 CHANGE ORDER PROCEDURES**

- A. On Owner's approval of a Proposal Request, the Designer or Owner Representative will issue a Change Order for signatures of Owner and Contractor on the "Change Order" form.

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION (Not Used)**

**END OF SECTION 012600**

## **SECTION 013100 – COORDINATION**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract including General and Supplementary Conditions and other Division 1 Specification Sections apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes administrative provisions for coordinating construction operations on Projects including, but not limited to, the following:
  - 1. Coordination Drawings.
  - 2. Administrative and supervisory personnel.
  - 3. Project meetings.
- B. Each Contractor shall participate in coordination requirements. Certain areas of responsibility will be assigned to a specific Contractor.
- C. Related Sections include the following:
  - 1. Division 1, Section 013200 "Schedules" for preparing and submitting Contractor's Construction Schedule.
  - 2. Articles 1.8.B and 1.8.C of Section 007213 "General Conditions" for coordinating meetings onsite.
  - 3. Article 5.4.H of Section 007213 "General Conditions" for coordinating Closeout of the Contract.

#### **1.3 COORDINATION**

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections, which depend on each other for proper installation, connection, and operation.
- B. Coordination: Each Contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each Contractor shall coordinate its operations with operations included in different Sections that depend on each other for proper installation, connection, and operation.
  - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
  - 2. Coordinate installation of different components with other Contractors to ensure maximum accessibility for required maintenance, service, and repair.
  - 3. Make adequate provisions to accommodate items scheduled for later installation.
  - 4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required



maintenance, service, and repair of all components including mechanical and electrical.

- C. Prepare memoranda for distribution to each party involved outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
  - 1. Prepare similar memoranda for Owner and separate Contractors if coordination of their Work is required.
  
- D. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other Contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
  - 1. Preparation of Contractor's Construction Schedule.
  - 2. Preparation of the Schedule of Values.
  - 3. Installation and removal of temporary facilities and controls.
  - 4. Delivery and processing of submittals.
  - 5. Progress meetings.
  - 6. Preinstallation conferences.
  - 7. Startup and adjustment of systems.
  - 8. Project Closeout activities.
  
- E. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.
  - 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. Refer to other Sections for disposition of salvaged materials that are designated as Owner's property.

#### **1.4 SUBMITTALS**

- A. Coordination Drawings: Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.
  
- B. Key Personnel Names: Within fifteen (15) work days of starting construction operations, submit a list of key personnel assignments including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers including home and office telephone numbers. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.
  - 1. Post copies of list in Project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

#### **1.5 PROJECT MEETINGS**

- A. The Owner's Construction Representative will schedule a Pre-Construction Meeting prior to beginning of construction. The date, time, and exact place of this meeting will be determined after Contract Award and notification of all interested parties. The

Contractor shall arrange to have the Job Superintendent and all prime Subcontractors present at the meeting. During the Pre-Construction Meeting, the construction procedures and information necessary for submitting payment requests will be discussed and materials distributed along with any other pertinent information.

1. Minutes: Designer will record and distribute meeting minutes.
- B. Progress Meetings: The Owner's Construction Representative will conduct Monthly Progress Meetings as stated in Articles 1.8.B and 1.8.C of Section 007213 "General Conditions".
1. Minutes: Designer will record and distribute to Contractor the meeting minutes.
- C. Preinstallation Conferences: Contractor shall conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.
1. Attendees: Installer and representatives of Manufacturers and Fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Designer and Construction Representative of scheduled meeting dates.
  2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration including requirements for the following:
    - a. Contract Documents
    - b. Options
    - c. Related RFIs
    - d. Related Change Orders
    - e. Purchases
    - f. Deliveries
    - g. Submittals
    - h. Review of mockups
    - i. Possible conflicts
    - j. Compatibility problems
    - k. Time schedules
    - l. Weather limitations
    - m. Manufacturer's written recommendations
    - n. Warranty requirements
    - o. Compatibility of materials
    - p. Acceptability of substrates
    - q. Temporary facilities and controls
    - r. Space and access limitations
    - s. Regulations of authorities having jurisdiction
    - t. Testing and inspecting requirements

- u. Installation procedures
  - v. Coordination with other Work
  - w. Required performance results
  - x. Protection of adjacent Work
  - y. Protection of construction and personnel
3. Contractor shall record significant conference discussions, agreements, and disagreements including required corrective measures and actions.
  4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.
  5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
  6. Revise paragraph below if Project requires holding progress meetings at different intervals. Insert special intervals such as "every third Tuesday" to suit special circumstances.
  7. Project name
  8. Name and address of Contractor
  9. Name and address of Designer
  10. RFI number including RFIs that were dropped and not submitted
  11. RFI description
  12. Date the RFI was submitted
  13. Date Designer's response was received
  14. Identification of related DSI or Proposal Request, as appropriate

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION (Not Used)**

**END OF SECTION 013100**

## **SECTION 013115 - PROJECT MANAGEMENT COMMUNICATIONS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract including General and Supplementary Conditions, Bid Form, and other Division 1 Specification Sections apply to this Section.
- B. Division 1, Section 013300 - Submittals
- C. Division 1, Section 012600 – Contract Modification Procedures

#### **1.2 SUMMARY**

- A. Project Management Communications: The Contractor shall use the Internet web based project management communications tool, E-Builder<sup>®</sup> ASP software, and protocols included in that software during this project. The use of project management communications as herein described does not replace or change any contractual responsibilities of the participants.
  - 1. Project management communications is available through E-Builder<sup>®</sup> as provided by "e-Builder<sup>®</sup>" in the form and manner required by the Owner.
  - 2. The project communications database is on-line and fully functional. User registration, electronic and computer equipment, and Internet connections are the responsibility of each project participant. The sharing of user accounts is prohibited
- B. Support: E-Builder<sup>®</sup> will provide on-going support through on-line help files.
- C. Copyrights and Ownership: Nothing in this specification or the subsequent communications supersedes the parties' obligations and rights for copyright or document ownership as established by the Contract Documents. The use of CAD files, processes or design information distributed in this system is intended only for the project specified herein.
- D. Purpose: The intent of using E-Builder<sup>®</sup> is to improve project work efforts by promoting timely initial communications and responses. Secondly, to reduce the number of paper documents while providing improved record keeping by creation of electronic document files
- E. Authorized Users: Access to the web site will be by individuals who are authorized users.
  - 1. Individuals shall complete the E-Builder New Company/User Request Form located at the following web site: <https://oa.mo.gov/facilities/vendor-links/contractor-forms>.

Completed forms shall be emailed to the following email address: [OA.FMDCE-BuilderSupport@oa.mo.gov](mailto:OA.FMDCE-BuilderSupport@oa.mo.gov).

2. Authorized users will be contacted directly and assigned a temporary user password.
  3. Individuals shall be responsible for the proper use of their passwords and access to data as agents of the company in which they are employed.
- F. Administrative Users: Administrative users have access and control of user licenses and all posted items. **DO NOT POST PRIVATE OR YOUR COMPANY CONFIDENTIAL ITEMS IN THE DATABASE!** Improper or abusive language toward any party or repeated posting of items intended to deceive or disrupt the work of the project will not be tolerated and will result in deletion of the offensive items and revocation of user license at the sole discretion of the Administrative User(s).
- G. Communications: The use of fax, email and courier communication for this project is discouraged in favor of using E-Builder® to send messages. Communication functions are as follows:
1. Document Integrity and Revisions:
    - a. Documents, comments, drawings and other records posted to the system shall remain for the project record. The authorship time and date shall be recorded for each document submitted to the system. Submitting a new document or record with a unique ID, authorship, and time stamp shall be the method used to make modifications or corrections.
    - b. The system shall make it easy to identify revised or superseded documents and their predecessors.
    - c. Server or Client side software enhancements during the life of the project shall not alter or restrict the content of data published by the system. System upgrades shall not affect access to older documents or software.
  2. Document Security:
    - a. The system shall provide a method for communication of documents. Documents shall allow security group assignment to respect the contractual parties communication except for Administrative Users. **DO NOT POST PRIVATE OR YOUR COMPANY CONFIDENTIAL ITEMS IN THE DATABASE!**
  3. Document Integration:
    - a. Documents of various types shall be logically related to one another and discoverable. For example, requests for information, daily field reports, supplemental sketches and photographs shall be capable of reference as related records.
  4. Reporting:
    - a. The system shall be capable of generating reports for work in progress, and logs for each document type. Summary reports generated by the system shall be available for team members.
  5. Notifications and Distribution:
    - a. Document distribution to project members shall be accomplished both within the extranet system and via email as appropriate. Project document distribution to parties outside of the project communication system shall be

accomplished by secure email of outgoing documents and attachments, readable by a standard email client.

6. Required Document Types:
  - a. RFI, Request for Information.
  - b. Submittals, including record numbering by drawing and specification section.
  - c. Transmittals, including record of documents and materials delivered in hard copy.
  - d. Meeting Minutes.
  - e. Application for Payments (Draft or Pencil).
  - f. Review Comments.
  - g. Field Reports.
  - h. Construction Photographs.
  - i. Drawings.
  - j. Supplemental Sketches.
  - k. Schedules.
  - l. Specifications.
  - m. Request for Proposals
  - n. Designer's Supplemental Instructions
  - o. Punch Lists

H. Record Keeping: Except for paper documents, which require original signatures and large format documents (greater than 8½ x 11 inches), all other 8½ x 11 inches documents shall be submitted by transmission in electronic form to the E-Builder® web site by licensed users.

- a. The Owner and his representatives, the Designer and his consultants, and the Contractor and his Sub Contractors and suppliers at every tier shall respond to documents received in electronic form on the web site, and consider them as if received in paper document form.
- b. The Owner and his representatives, the Designer and his consultants, and the Contractor and his Sub Contractors and suppliers at every tier reserves the right to and shall reply or respond by transmissions in electronic form on the web site to documents actually received in paper document form.
- c. The Owner and his representatives, the Designer and his consultants, and the Contractor and his Sub Contractors and suppliers at every tier reserves the right to and shall copy any paper document into electronic form and make same available on the web site.

I. Minimum Equipment and Internet Connection: In addition to other requirements specified in this Section, the Owner and his representatives, the Construction Manager and his representatives, the Architect and his consultants, and the Contractor and his sub-contractors and suppliers at every tier required to have a user license(s) shall be responsible for the following:

1. Providing suitable computer systems for each licensed user at the users normal work location<sup>1</sup> with high-speed Internet access, i.e. DSL, local cable company's Internet connection, or T1 connection.
2. Each of the above referenced computer systems shall have the following minimum system<sup>2</sup> and software requirements:
  - a. Desktop configuration (Laptop configurations are similar and should be equal to or exceed desktop system.)
    - 1) Operating System: Windows XP or newer
    - 2) Internet Browser: Internet Explorer 6.01SP2+ (Recommend IE7.0+)
    - 3) Minimum Recommend Connection Speed: 256K or above
    - 4) Processor Speed: 1 Gigahertz and above
    - 5) RAM: 512 mb
    - 6) Operating system and software shall be properly licensed.
    - 7) Internet Explorer version 7 (current version is a free distribution for download). This specification is not intended to restrict the host server or client computers provided that industry standard HTTP clients may access the published content.
    - 8) Adobe Acrobat Reader (current version is a free distribution for download).
    - 9) Users should have the standard Microsoft Office Suite (current version must be purchased) or the equivalent.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable.)

END OF SECTION 013115

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<sup>1</sup> The normal work location is the place where the user is assigned for more than one-half of his time working on this project.

<sup>2</sup> The minimum system herein will not be sufficient for many tasks and may not be able to process all documents and files stored in the E-Builder® Documents area.

## **SECTION 013200 – SCHEDULE – BAR CHART**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract including General and Supplementary Conditions, Bid Form, and other Division 1 Specification Sections apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes requirements for a Bar Chart Schedule for the project construction activities, schedule of submittals, and schedule for testing.

### **PART 2 - PRODUCTS – (Not Applicable)**

### **PART 3 - EXECUTION**

#### **3.1 SUBMITTAL PROCEDURES**

- A. The Contractor shall submit to the Designer, within ten (10) working days following the Notice to Proceed, a Progress Schedule including Schedule of Values showing the rate of progress the Contractor agrees to maintain and the order in which he proposed to carry out the various phases of Work. No payments shall be made to the Contractor until the Progress Schedule has been approved by the Owner.
  - 1. The Schedule of Values must have the following line items included with the value of the item as indicated below:
    - a. O&M's (Owner's Manual)
      - 1) Over \$1,000,000.00 (One million) – 1% of the total contract amount
    - b. Close Out Documents
      - 1) Over \$1,000,000.00 (One million) – 1% of the total contract amount
    - c. General Conditions
      - 1) No more than 10%
- B. The Contractor shall submit an updated Schedule for presentation at each Monthly Progress Meeting. The Schedule shall be updated by the Contractor as necessary to reflect the current Schedule and its relationship to the original Schedule. The updated Schedule shall reflect any changes in the logic, sequence, durations, or completion date. Payments to the Contractor shall be suspended if the Progress Schedule is not adequately updated to reflect actual conditions.
- C. The Contractor shall submit Progress Schedules to Subcontractors to permit coordinating their Progress Schedules to the general construction Work. The Contractor shall coordinate preparation and processing of Schedules and reports with performance of other construction activities.



### 3.2 CONSTRUCTION PROGRESS SCHEDULE – BAR CHART SCHEDULE

- A. Bar-Chart Schedule: The Contractor shall prepare a comprehensive, fully developed, horizontal bar chart-type Contractor’s Construction Schedule. The Contractor for general construction shall prepare the Construction Schedule for the entire Project. The Schedule shall show the percentage of work to be completed at any time, anticipated monthly payments by Owner, as well as significant dates (such as completion of excavation, concrete foundation work, underground lines, superstructure, rough-ins, enclosure, hanging of fixtures, etc.) which shall serve as check points to determine compliance with the approved Schedule. The Schedule shall also include an activity for the number of “bad” weather days specified in Section 012100 – Allowances.
1. The Contractor shall provide a separate time bar for each significant construction activity. Provide a continuous vertical line to identify the first working day of each week.
    - a. If practical, use the same Schedule of Values breakdown for schedule time bars.
  2. The Contractor shall provide a base activity time bar showing duration for each construction activity. Each bar is to indicate start and completion dates for the activity. The Contractor is to place a contrasting bar below each original schedule activity time for indicating actual progress and planned remaining duration for the activity.
  3. The Contractor shall prepare the Schedule on a minimal number of separate sheets to readily show the data for the entire construction period.
  4. Secure time commitments for performing critical elements of the Work from parties involved. Coordinate each element on schedule with other construction activities. Include minor elements involved in the overall sequence of the Work. Show each activity in proper sequence. Indicate graphically the sequences necessary for completion of related portions of the Work.
  5. Coordinate the Contractor’s Construction Schedule with the Schedule of Values, list of subcontracts, Submittal Schedule, progress reports, payment requests, and other required schedules and reports.
  6. Indicate the Intent to Award and the Contract Substantial Completion dates on the schedule.
- B. Phasing: Provide notations on the schedule to show how the sequence of the Work is affected by the following:
1. Requirement for Phased completion
  2. Work by separate Contractors
  3. Work by the Owner
  4. Pre-purchased materials
  5. Coordination with existing construction
  6. Limitations of continued occupancies
  7. Un-interruptible services
  8. Partial Occupancy prior to Substantial Completion
  9. Site restrictions
  10. Provisions for future construction

11. Seasonal variations
  12. Environmental control
- C. Work Stages: Use crosshatched bars to indicate important stages of construction for each major portion of the Work. Such stages include, but are not necessarily limited to, the following:
1. Subcontract awards
  2. Submittals
  3. Purchases
  4. Mockups
  5. Fabrication
  6. Sample testing
  7. Deliveries
  8. Installation
  9. Testing
  10. Adjusting
  11. Curing
  12. Startup and placement into final use and operation
- D. Area Separations: Provide a separate time bar to identify each major area of construction for each major portion of the Work. For the purposes of this Article, a “major area” is a story of construction, a separate building, or a similar significant construction element.
1. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
    - a. Structural completion.
    - b. Permanent space enclosure
    - c. Completion of mechanical installation
    - d. Completion of the electrical portion of the Work
    - e. Substantial Completion

### **3.3 SCHEDULE OF SUBMITTALS**

- A. Upon acceptance of the Construction Progress Schedule, prepare and submit a complete schedule of submittals. Coordinate the submittal schedule with Section 013300 SUBMITTALS, the approved Construction Progress Schedule, list of subcontracts, Schedule of Values and the list of products.
- B. Prepare the schedule in chronological order. Provide the following information
1. Scheduled date for the first submittal
  2. Related Section number
  3. Submittal category
  4. Name of the Subcontractor

5. Description of the part of the Work covered
  6. Scheduled date for resubmittal
  7. Scheduled date for the Designer's final release or approval
- C. Distribution: Following the Designer's response to the initial submittal schedule, print and distribute copies to the Designer, Owner, subcontractors, and other parties required to comply with submittal dates indicated.
1. Post copies in the Project meeting room and temporary field office.
  2. When revisions are made, distribute to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned part of the Work and are no longer involved in construction activities.
- D. Schedule Updating: Revise the schedule after each meeting or other activity where revisions have been recognized or made. Issue the updated schedule concurrently with the report of each meeting.

### **3.4 SCHEDULE OF INSPECTIONS AND TESTS**

- A. Prepare a schedule of inspections, tests, and similar services required by the Contract Documents. Submit the schedule with (15) days of the date established for commencement of the Contract Work. The Contractor is to notify the testing agency at least (5) working days in advance of the required tests unless otherwise specified.
- B. Form: This schedule shall be in tabular form and shall include, but not be limited to, the following:
1. Specification Section number
  2. Description of the test
  3. Identification of applicable standards
  4. Identification of test methods
  5. Number of tests required
  6. Time schedule or time span for tests
  7. Entity responsible for performing tests
  8. Requirements for taking samples
  9. Unique characteristics of each service
- C. Distribution: Distribute the schedule to the Owner, Architect, and each party involved in performance of portions of the Work where inspections and tests are required.

**END OF SECTION 013200**

## **SECTION 013300 – SUBMITTALS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract including General and Supplementary Conditions, Bid Form, and other Division 1 Specification Sections apply to this Section.
- B. Division 1, Section 013115 “Project Management Communications” for administrative requirements for communications.

#### **1.2 SUMMARY**

- A. This Section includes administrative and procedural requirements for submittals required for performance of the Work including the following:
  - 1. Shop Drawings
  - 2. Product Data
  - 3. Samples
  - 4. Quality Assurance Submittals
  - 5. Construction Photographs
  - 6. Operating and Maintenance Manuals
  - 7. Warranties
- B. Administrative Submittals: Refer to General and Supplementary Conditions other applicable Division 1 Sections and other Contract Documents for requirements for administrative submittals. Such submittals include, but are not limited to, the following:
  - 1. Construction Progress Schedule including Schedule of Values
  - 2. Performance and Payment Bonds
  - 3. Insurance Certificates
  - 4. Applications for Payment
  - 5. Certified Payroll Reports
  - 6. Partial and Final Receipt of Payment and Release Forms
  - 7. Affidavit – Compliance with Prevailing Wage Law
  - 8. Record Drawings
  - 9. Notifications, Permits, etc.
- C. The Contractor is obliged and responsible to check all shop drawings and schedules to assure compliance with contract plans and specifications. The Contractor is responsible for the content of the shop drawings and coordination with other contract work. Shop drawings and schedules shall indicate, in detail, all parts of an Item or Work including erection and setting instructions and integration with the Work of other trades.
- D. The Contractor shall at all times make a copy, of all approved submittals, available on site to the Construction Representative.

### **1.3 SUBMITTAL PROCEDURES**

- A. The Contractor shall comply with the General and Supplementary Conditions and other applicable sections of the Contract Documents. The Contractor shall submit, with such promptness as to cause no delay in his work or in that of any other contractors, all required submittals indicated in Part 3.1 of this section and elsewhere in the Contract Documents. Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.
  - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
  - 2. Coordinate transmittal of different types of submittals for related elements of the Work so processing will not be delayed by the need to review submittals concurrently for coordination.
    - a. The Designer reserves the right to withhold action on a submittal requiring coordination with other submittals until all related submittals are received.
  
- B. Each drawing and/or series of drawings submitted must be accompanied by a letter of transmittal giving a list of the titles and numbers of the drawings. Each series shall be numbered consecutively for ready reference and each drawing shall be marked with the following information:
  - 1. Date of Submission
  - 2. Name of Project
  - 3. Location
  - 4. Section Number of Specification
  - 5. State Project Number
  - 6. Name of Submitting Contractor
  - 7. Name of Subcontractor
  - 8. Indicate if Item is submitted as specified or as a substitution

### **1.4 SHOP DRAWINGS**

- A. Comply with the General Conditions, Article 3.2.
  
- B. The Contractor shall submit newly prepared information drawn accurately to scale. Highlight, encircle, or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the basis of Shop Drawings. Standard information prepared without specific reference to the Project is not a Shop Drawing.
  
- C. Shop Drawings include fabrication and installation drawings, setting diagrams, schedules, patterns, templates, and similar drawings including the following information:
  - 1. Dimensions
  - 2. Identification of products and materials included by sheet and detail number
  - 3. Compliance with specified standards
  - 4. Notation of coordination requirements

5. Notation of dimensions established by field measurement
6. Sheet Size: Except for templates, patterns and similar full-size Drawings, submit Shop Drawings on sheets at least 8½"x11" but no larger than 36"x48".

## **1.5 PRODUCT DATA**

- A. The Contractor shall comply with the General Conditions, Article 3.2.
- B. The Contractor shall collect Product Data into a single submittal for each element of construction or system. Product Data includes printed information, such as manufacturer's installation instructions, catalog cuts, standard color charts, roughing-in diagrams and templates, standard wiring diagrams, and performance curves.
  1. Mark each copy to show applicable choices and options. Where printed Product Data includes information on several products that are not required, mark copies to indicate the applicable information including the following information:
    - a. Manufacturer's printed recommendations
    - b. Compliance with Trade Association standards
    - c. Compliance with recognized Testing Agency standards
    - d. Application of Testing Agency labels and seals
    - e. Notation of dimensions verified by field measurement
    - f. Notation of coordination requirements
  2. Do not submit Product Data until compliance with requirements of the Contract Documents has been confirmed.

## **1.6 SAMPLES**

- A. The Contractor shall comply with the General Conditions, Article 3.2.
- B. The Contractor shall submit full-size, fully fabricated samples, cured and finished as specified, and physically identical with the material or product proposed. Samples include partial sections of manufactured or fabricated components, cuts or containers of materials, color range sets, and swatches showing color, texture, and pattern.
  1. The Contractor shall mount or display samples in the manner to facilitate review of qualities indicated. Prepare samples to match the Designer's sample including the following:
    - a. Specification Section number and reference
    - b. Generic description of the Sample
    - c. Sample source
    - d. Product name or name of the Manufacturer
    - e. Compliance with recognized standards
    - f. Availability and delivery time
  2. The Contractor shall submit samples for review of size, kind, color, pattern, and texture. Submit samples for a final check of these characteristics with other elements and a comparison of these characteristics between the final submittal and the actual component as delivered and installed.

- a. Where variation in color, pattern, texture, or other characteristic is inherent in the material or product represented, submit at least three (3) multiple units that show approximate limits of the variations.
  - b. Refer to other Specification Sections for requirements for samples that illustrate workmanship, fabrication techniques, details of assembly, connections, operation, and similar construction characteristics.
  - c. Refer to other Sections for samples to be returned to the Contractor for incorporation in the Work. Such samples must be undamaged at time of use. On the transmittal, indicate special requests regarding disposition of sample submittals.
  - d. Samples not incorporated into the Work, or otherwise designated as the Owner's property, are the property of the Contractor and shall be removed from the site prior to Substantial Completion.
3. Field samples are full-size examples erected onsite to illustrate finishes, coatings, or finish materials and to establish the Project standard.
    - a. The Contractor shall comply with submittal requirements to the fullest extent possible. The Contractor shall process transmittal forms to provide a record of activity.

## **1.7 QUALITY ASSURANCE DOCUMENTS**

- A. The Contractor shall comply with the General Conditions, Article 3.2
- B. The Contractor shall submit quality control submittals including design data, certifications, manufacturer's instructions, manufacturer's field reports, and other quality-control submittals as required under other Sections of the Specifications.
- C. Certifications: Where other Sections of the Specifications require certification that a product, material, or installation complies with specified requirements, submit a notarized certification from the Manufacturer certifying compliance with specified requirements.
  1. Signature: Certification shall be signed by an officer of the Manufacturer or other individual authorized to contractually bind the Company.
- D. Inspection and Test Reports: The Contractor shall submit the required inspection and test reports from independent testing agencies as specified in this Section and in other Sections of the Contract Documents.
- E. Construction Photographs: The Contractor shall submit record construction photographs as specified in this Section and in other Sections of the Contract Documents.
  1. The Contractor shall submit digital photographs. The Construction Administrator shall determine the quantity and naming convention at the preconstruction meeting.
  2. The Contractor shall identify each photograph with project name, location, number, date, time, and orientation.
  3. The Contractor shall submit progress photographs monthly unless specified otherwise. Photographs shall be taken one (1) week prior to submitting.
  4. The Contractor shall take four (4) site photographs from differing directions and a minimum of five (5) interior photographs indicating the relative progress of the Work.

**1.8 OPERATING AND MAINTENANCE MANUALS AND WARRANTIES**

- A. The Contractor shall submit all required manufacturer’s operating instructions, maintenance/service manuals, and warranties in accordance with the General Conditions, Article 3.5, and Supplementary Conditions along with this and other Sections of the Contract Documents.

**PART 2 - PRODUCTS (Not Applicable)**

**PART 3 - EXECUTION**

**3.1 REQUIRED SUBMITTALS**

- A. Contractor shall submit the following information for materials and equipment to be provided under this contract.

<b>SPEC SECTION</b>	<b>TITLE</b>	<b>CATEGORY</b>
013200	Schedules	Construction Schedule
013200	Schedules	Schedule of Values
013200	Schedules	List of Subcontractors
013200	Schedules	Major Material Suppliers
051200	Structural Steel Framing	Shop Drawings
230593	Testing, Adjusting, and Balancing (Certification, Test Report)	Test Report
230713	Duct Installation	Shop Drawings
233113	Metal Ducts	Shop Drawings
233346	Flexible Ducts	Shop Drawings
233600	Air Terminal Units	Shop Drawings
233713	Air Diffusers	Shop Drawings
237416	Packaged Large Capacity Rooftop Air Conditioning Units (Product Data, Operation / Maintenance Manual, Warranty)	Shop Drawings
262416	Electrical Panelboards	Shop Drawings
262813	Fuses	Product Data
262816	Enclosed Switches and Circuit Breakers (Product Data, Warranty, Operation / Maintenance Manual)	Shop Drawings

**END OF SECTION 013300**



## **SECTION 013513.25 – SITE SECURITY AND HEALTH REQUIREMENTS (MSHP)**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract including General and Supplementary Conditions, Bid Form, and other Division 1 Specification Sections apply to this Section.

#### **1.2 SUBMITTALS**

- A. List of required submittals:
  - 1. Materials Safety Data Sheets for all hazardous materials to be brought onsite.
  - 2. Schedule of proposed shutdowns, if applicable.
  - 3. A list of the names of all employees who will submit fingerprints for a background check, and the signed privacy documents identified below for each employee.

### **PART 2 - PRODUCTS (Not Applicable)**

### **PART 3 - EXECUTION**

#### **3.1 ACCESS TO THE SITE**

- A. The Contractor shall arrange with Facility Representatives to establish procedures for the controlled entry of workers and materials into the work areas at the Facility.
- B. The Contractor shall establish regular working hours with Facility Representatives. The Contractor must report changes in working hours or overtime to Facility Representatives and obtain approval twenty-four (24) hours ahead of time. The Contractor shall report emergency overtime to Facility Representatives as soon as it is evident that overtime is needed. The Contractor must obtain approval from Facility Representatives for all work performed after dark.
- C. The Contractor shall provide the name and phone number of the Contractor's employee or agent who is in charge onsite; this individual must be able to be contacted in case of emergency. The Contractor must be able to furnish names and address of all employees upon request.
- D. All construction personnel shall visibly display issued identification cards.

#### **3.2 FIRE PROTECTION, SAFETY, AND HEALTH CONTROLS**

- A. The Contractor shall take all necessary precautions to guard against and eliminate possible fire hazards.
  - 1. Onsite burning is prohibited.
  - 2. The Contractor shall store all flammable or hazardous materials in proper containers located outside the buildings or offsite, if possible.
  - 3. The Contractor shall provide and maintain, in good order, during construction fire extinguishers as required by the National Fire Protection Association. In areas of

flammable liquids, asphalt, or electrical hazards, 15-pound carbon dioxide or 20-pound dry chemical extinguishers shall be provided.

- B. The Contractor shall not obstruct streets or walks without permission from the Owner's Construction Representative and Facility Representatives.
- C. The Contractor's personnel shall not exceed the speed limit of 15 mph while at the Facility unless otherwise posted.
- D. The Contractor shall take all necessary, reasonable measures to reduce air and water pollution by any material or equipment used during construction. The Contractor shall keep volatile wastes in covered containers, and shall not dispose of volatile wastes or oils in storm or sanitary drains.
- E. The Contractor shall keep the project site neat, orderly, and in a safe condition at all times. The Contractor shall immediately remove all hazardous waste, and shall not allow rubbish to accumulate. The Contractor shall provide onsite containers for collection of rubbish and shall dispose of it at frequent intervals during the progress of the Work.
- F. Fire exits, alarm systems, and sprinkler systems shall remain fully operational at all times, unless written approval is received from the Owner's Construction Representative and the appropriate Facility Representative at least twenty-four (24) hours in advance. The Contractor shall submit a written time schedule for any proposed shutdowns.
- G. For all hazardous materials brought onsite, Material Safety Data Sheets shall be on site and readily available upon request at least a day before delivery.
- H. Alcoholic beverages or illegal substances shall not be brought upon the Facility premises. The Contractor's workers shall not be under the influence of any intoxicating substances while on the Facility premises.

### **3.3 MSHP SECURITY CLEARANCE REQUIREMENTS**

- A. Contractor Background Screening Policy: As a normal business activity, the Missouri State Highway Patrol (MSHP) may contract with external companies to perform various duties for the Missouri State Highway Patrol. Any personnel working for a contractor, and who has access to criminal justice information is required to pass a background check prior to beginning work on the contract. A contractor's proposed candidate may also be required to undergo a MSHP approved drug screening. This background check requirement will be included as part of all PAQs or solicitations for bids. The contract/PAQ award is contingent upon the proposed candidate background checks being completed.
- B. This background check will include, but not be limited to, state of residency and national fingerprint-based record checks. If the proposed candidate lives outside the United States, the contractor will submit similar documentation from their respective country. Qualification to work on contract will be based upon the following criteria:
  - 1. A felony conviction or guilty plea will be an automatic disapproval of the candidate.
  - 2. Any conviction whether misdemeanor or felony, involving violence, crimes against children, and all sexual crimes regardless of timeframe will be an automatic disapproval of the candidate.
  - 3. Candidates will be disqualified if it is confirmed there are outstanding arrest warrants for the candidate.

4. Any other misdemeanor convictions and guilty pleas may be considered for automatic disapproval. The State CSO (CJIS Security Officer) has final authority regarding if the nature or severity of the misdemeanor offense(s) does or does not warrant a disqualification.
- C. For misdemeanors, consideration will be given to the relationship between the information obtained in the background check and the responsibilities of the position. Time and severity of crime may also be considered as factors in a disqualification. Candidates may submit a written request for waiver through their contracting company if they have been disapproved and wish to contest the decision. The request will need to explain the circumstances of the crime and justification for a waiver.
- D. Contractors will be required to undergo a background check at a minimum once every five years. If there is a significant gap between contracts, candidates may be required to undergo a background check before working under a new contract.
- E. The CSO or their designee will maintain a list of contractors who have been approved to work at the MSHP.
- F. If a candidate goes through a background check with one contractor and then goes to work at a different contractor, the candidate will not be required to undergo a separate background check unless the timeframe exceeds five-year limit.
- G. The CSO for the MSHP has the right to approve or disapprove any candidate and has the right to revoke a candidate's approval at any time.
- H. The FBI CJIS Security Policy requires the MSHP to conduct background checks on all contractors needing MSHP access.
- I. Contractors working on-site and/or need **escorted access** are required to provide name, date of birth and social security number to enable the MSHP to run a name based background check prior to their arrival on-site.
- J. Contractors working on-site with **unescorted access and/or need access to our network** are required to submit fingerprints. Required fields for print cards are as follows:
  1. ORI: MOMHP0070
  2. OCA: CONTRACTOR
  3. Employer and Address: COMPANY NAME AND ADDRESS
  4. Reason Fingerprinted: CONTRACTOR
- K. Contractors may submit fingerprints either at the MSHP General Headquarters, Annex Building, front office located at 1510 East Elm Street, Jefferson City, MO 65109, or may go to their local law enforcement agency to obtain a "copy" of their fingerprints (ten print or digital). There is a processing fee of \$33.25 per applicant. We accept check or money orders made payable to the "Criminal Record System Fund". Credit card and debit cards only accepted at our location, no cash please. Fingerprints with processing fee can be mailed to the address below:

Missouri State Highway Patrol  
Criminal Justice Information Services Division  
Attn: Accounting, Annex Bldg.  
1510 East Elm Street

Post Office Box 9500  
Jefferson City, MO 65102-9500

- L. Once background checks are completed, results will be returned via encrypted email to the requestor. Processing time varies. Please contact the Security Audit and Compliance Unit for questions at 573-526-6153 x2658.

### **3.4 DISRUPTION OF UTILITIES**

- A. The Contractor shall give a minimum of seventy-two (72) hours written notice to the Construction Representative and the Facility Representative before disconnecting electric, gas, water, fire protection, or sewer service to any building.
- B. The Contractor shall give a minimum of seventy-two (72) hours written notice to the Construction Representative and Facility Representative before closing any access drives, and shall make temporary access available, if possible. The Contractor shall not obstruct streets, walks, or parking.

**END OF SECTION 013513.25**

## **SECTION 015000 – CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract including General and Supplementary Conditions, Bid Form, and other Division 1 Specification Sections apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes requirements for construction facilities and temporary controls including temporary utilities, support facilities, security, and protection.
- B. Temporary utilities include, but are not limited to, the following:
  - 1. Water service and distribution
  - 2. Temporary electric power and light
  - 3. Temporary heat
  - 4. Ventilation
  - 5. Sanitary facilities, including drinking water
- C. Support facilities include, but are not limited to, the following:
  - 1. Temporary elevator use
  - 2. Construction aids and miscellaneous services and facilities
- D. Security and protection facilities include, but are not limited to, the following:
  - 1. Environmental protection

#### **1.3 SUBMITTALS**

- A. Temporary Utilities: Submit reports of tests, inspections, meter readings, and similar procedures performed on temporary utilities.
- B. Implementation and Termination Schedule: Within (15) days of the date established for commencement of the Work, submit a schedule indicating implementation and termination of each temporary utility.

#### **1.4 QUALITY ASSURANCE**

- A. Regulations: Comply with industry standards and applicable laws and regulations including, but not limited to, the following:
  - 1. Building code requirements
  - 2. Health and safety regulations
  - 3. Utility company regulations
  - 4. Police, fire department, and rescue squad rules
  - 5. Environmental protection regulations

- B. Standards: Comply with NFPA 241 “Standard for Safeguarding Construction, Alterations, and Demolition Operations”. ANSI A10 Series standards for “Safety Requirements for Construction and Demolition”, and NECA Electrical Design Library “Temporary Electrical Facilities”.
  - 1. Electrical Service: Comply with NEMA, NECA, and UL standards and regulations for temporary electric service. Install service in compliance with NFPA 70 “National Electric Code”.
- C. Inspections: Arrange for authorities having jurisdiction to inspect and test each temporary utility before use. Obtain required certifications and permits.

## **1.5 PROJECT CONDITIONS**

- A. Temporary Utilities: Prepare a schedule indicating dates for implementation and termination of each temporary utility. At the earliest feasible time, when acceptable to the Owner, change over from use of temporary service to use of permanent service.
- B. Conditions of Use: Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Relocate temporary services and facilities as the Work progresses. Do not overload facilities or permit them to interfere with progress. Take necessary fire-prevention measures. Do not allow hazardous, dangerous, or unsanitary conditions, or public nuisances to develop or persist onsite.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. General: Provide new materials. If acceptable to the Designer, the Contractor may use undamaged, previously used materials in serviceable condition. Provide materials suitable for use intended.
- B. Lumber and Plywood: Comply with requirements in Division 6 Section “Rough Carpentry”.
  - 1. For job-built temporary office, shops, and sheds within the construction area, provide UL-labeled, fire-treated lumber and plywood for framing, sheathing, and siding.
  - 2. For signs and directory boards, provide exterior-type, Grade B-B high-density concrete form overlay plywood of sized and thicknesses indicated.
  - 3. For fences and vision barriers, provide minimum 3/9” (9.5mm) thick exterior plywood.
  - 4. For safety barriers, sidewalk bridges, and similar uses, provide minimum 5/8” (16mm) thick exterior plywood.
- C. Gypsum Wallboard: Provide gypsum wallboard on interior walls of temporary offices.
- D. Roofing Materials: Provide UL Class A standard-weight asphalt shingles or UL Class C mineral-surfaced roll roofing on roofs of job-built temporary office, shops, and shed.
- E. Paint: Comply with requirements of Division 9 Section “Painting”.
  - 1. For job-built temporary offices, shops, sheds, fences, and other exposed lumber and plywood, provide exterior-grade acrylic-latex emulsion over exterior primer.

2. For sign panels and applying graphics, provide exterior-grade alkyd gloss enamel over exterior primer.
  3. For interior walls of temporary offices, provide two (2) quarts interior latex-flat wall paint.
- F. Tarpaulins: Provide waterproof, fire-resistant, UL-labeled tarpaulins with flame-spread rating of (15) or less. For temporary enclosures, provide translucent, nylon-reinforced laminated polyethylene or polyvinyl chloride, fire-retardant tarpaulins.
- G. Water: Provide potable water approved by local health authorities.
- H. Open-Mesh Fencing: Provide 0.120" (3mm) thick, galvanized 2" (50mm) chainlink fabric fencing 6' (2m) high with galvanized steel pipe posts, 1½" (38mm) ID for line posts and 2½" (64mm) ID for corner posts.

## 2.2 EQUIPMENT

- A. General: Provide new equipment. If acceptable to the Designer, the Contractor may use undamaged, previously used equipment in serviceable condition. Provide equipment suitable for use intended.
- B. Water Hoses: Provide ¾" (19mm), heavy-duty, abrasion-resistant, flexible rubber hoses 100' (30m) long, with pressure rating greater than the maximum pressure of the water distribution system. Provide adjustable shutoff nozzles at hose discharge.
- C. Electrical Outlets: Provide properly configured, NEMA-polarized outlets to prevent insertion of 110 to 120V plugs into higher voltage outlets. Provide receptacle outlets equipped with ground-fault circuit interrupters, reset button, and pilot light for connection of power tools and equipment.
- D. Electrical Power Cords: Provide grounded extension cords. Use hard-service cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate lengths of electric cords if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length-voltage rating.
- E. Lamps and Light Fixtures: Provide general service incandescent lamps of wattage required for adequate illumination. Provide guard cages or tempered-glass enclosures where exposed to breakage. Provide exterior fixture where exposed to moisture.
- F. Heating Units: Provide temporary heating units that have been tested and labeled by UL, FM, or another recognized trade association related to the type of fuel being consumed.
- G. Temporary Offices: Provide prefabricated or mobile units or similar job-built construction with lockable entrances, operable windows, and serviceable finishes. Provide heated and air-conditioned units on foundations adequate for normal loading.
- H. Temporary Toilet Units: Provide self-contained, single-occupant toilet units of the chemical, aerated re-circulation, or combustion type. Provide units properly vented and fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material.
- I. Fire Extinguishers: Provide hand-carried, portable, UL-rated, Class A fire extinguishers for temporary offices and similar spaces. In other locations, provide hand-carried,

portable, UL-rated, Class ABC, dry-chemical extinguishers, or a combination of extinguishers of NFPA-recommended classes for the exposures.

1. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Use qualified personnel for installation of temporary facilities. Locate facilities where they will serve the Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required.
- B. Provide each Facility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

### **3.2 TEMPORARY UTILITY INSTALLATION**

- A. General: Engage the appropriate local utility company to install temporary service or connect to existing service. Where company provides only part of the service, provide the remainder with matching, compatible materials and equipment. Comply with company recommendations.
  1. Arrange with company and existing users for a time when service can be interrupted, if necessary, to make connections for temporary services.
  2. Provide adequate capacity at each stage of construction. Prior to temporary utility availability, provide trucked-in services.
  3. Obtain easements to bring temporary utilities to the site where the Owner's easements cannot be used for that purpose.
  4. Use Charges: Cost or use charges for temporary facilities are not chargeable to the Owner or Designer. Neither the Owner nor Designer will accept cost or use charges as a basis of claims for Change Order.
- B. Temporary Electric Power Service: The Owner will provide electric power for construction lighting and power tools. Contractors using such services shall pay all costs of temporary services, circuits, outlet, extensions, etc.
- C. Temporary Lighting: When existing lighting is out of service, provide temporary lighting with local switching.
  1. Install and operate temporary lighting that will fulfill security and protection requirements without operating the entire system. Provide temporary lighting that will provide adequate illumination for construction operations and traffic conditions.
- D. Temporary Heating and Cooling: The normal heating and/or cooling system of the building shall be maintained in operation during the construction. Should the Contractor find it necessary to interrupt the normal HVAC service to spaces, which have not been vacated for construction, such interruptions shall be pre-scheduled with the Construction Representative.



- E. Temporary Toilets: Use of the Owner's existing toilet facilities will be permitted, so long as facilities are cleaned and maintained in a condition acceptable to the Owner. All construction personnel will be allowed access only to those specific facilities designed by the Construction Representative. At substantial completion, restore these facilities to the condition prevalent at the time of initial use.
- F. Drinking-Water Facilities: The Owner will provide drinking water facilities within the building. All construction personnel will be allowed access only to those specific facilities designated by the Construction Representative.

### **3.3 SUPPORT FACILITIES INSTALLATION**

- A. General: Locate field offices, storage sheds, and other temporary construction and support facilities for easy access.
  - 1. Maintain support facilities until near Substantial Completion. Remove prior to Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to the Owner.
- B. Field Offices: Provide insulated, weathertight temporary offices of sufficient size to accommodate required office personnel at the Project site. Keep the office clean and orderly for use for small progress meetings. Furnish and equip office as follows:
  - 1. Furnish with a desk and chairs, a 4-drawer file cabinet, plan table, plan rack, and a 6-shelf bookcase.
  - 2. Equip with a water cooler and private toilet complete with water closet, lavatory, and medicine cabinet unit with a mirror.
- C. Storage Facilities: The Owner will provide storage onsite as designated by the Facility Representative or the Construction Representative. Areas for use by the Contractor for storage will be identified at the Pre-Bid Meeting.
- D. Construction Parking: Parking at the site will be provided in the areas designated at the Pre-Construction Meeting.
- E. Temporary Elevator Use: The Owner will allow use of elevators within the building. All construction personnel will be allowed access only to those specific elevators designated by the Construction Representative.
- F. Project Identification and Temporary Signs: Prepare project identification and other signs of size indicated. Install signs where indicated to inform the public and persons seeking entrance to the Project. Support on posts or framing of preservative-treated wood or steel. Do not permit installation of unauthorized signs.
  - 1. Project Identification Signs: Engage an experienced sign painter to apply graphics. Comply with details indicated.
  - 2. Temporary Signs: Prepare signs to provide directional information to construction personnel and visitors.
- G. Collection and Disposal of Waste: Collect waste from construction areas and elsewhere daily. Comply with requirements of NFPA 241 for removal of combustible waste material and debris. Enforce requirements strictly. Do not hold materials more than seven (7) days during normal weather or three (3) days when the temperature is expected

to rise above 80°F (27°C). Handle hazardous, dangerous, or unsanitary waste materials separately from other waste by containerizing properly. Dispose of material lawfully.

### **3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION**

- A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and minimize the possibility that air, waterways, and subsoil might be contaminated or polluted or that other undesirable effects might result. Avoid use of tools and equipment that produce harmful noise. Restrict use of noisemaking tools and equipment to hours that will minimize complaints from persons or firms near the site.

### **3.5 OPERATION, TERMINATION AND REMOVAL**

- A. Supervision: Enforce strict discipline in use of temporary facilities. Limit availability of temporary facilities to essential and intended uses to minimize waste and abuse.
- B. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage by freezing temperatures and similar elements.
  - 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
  - 2. Protection: Prevent water-filled piping from freezing. Maintain markers for underground lines. Protect from damage during excavation operations.

**END OF SECTION 015000**

## **SECTION 017400 – CLEANING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract including General and Supplementary Conditions, Bid Form, and other Division 1 Specification Sections apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes administrative and procedural requirements for cleaning during the Project.
- B. Environmental Requirements: Conduct cleaning and waste-disposal operations in compliance with local laws and ordinances. Comply fully with federal and local environmental and anti-pollution regulations.
  - 1. Do not dispose of volatile wastes such as mineral spirits, oil, or paint thinner in storm or sanitary drains.
  - 2. Burning or burying of debris, rubbish, or other waste material on the premises is not permitted.

### **PART 2 - PRODUCTS**

#### **2.1 MATERIALS**

- A. Cleaning Agents: Use cleaning materials and agents recommended by the manufacturer or fabricator for the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

### **PART 3 - EXECUTION**

#### **3.1 PROGRESS CLEANING**

- A. General
  - 1. Retain all stored items in an orderly arrangement allowing maximum access, not impeding drainage or traffic, and providing the required protection of materials.
  - 2. Do not allow the accumulation of scrap, debris, waste material, and other items not required for construction of this Work.
  - 3. At least <once><twice> each month, and more often if necessary, completely remove all scrap, debris, and waste material from the jobsite.
  - 4. Provide adequate storage for all items awaiting removal from the jobsite, observing all requirements for fire protection and protection of the ecology.
- B. Site
  - 1. Daily, inspect the site and pick up all scrap, debris, and waste material. Remove all such items to the place designated for their storage.
  - 2. Weekly, inspect all arrangements of materials stored onsite. Re-stack, tidy, or otherwise service all material arrangements.

3. Maintain the site in a neat and orderly condition at all times.

C. Structures

1. Daily, inspect the structures and pick up all scrap, debris, and waste material. Remove all such items to the place designated for their storage.
2. Weekly, sweep all interior spaces clean. "Clean" for the purposes of this paragraph, shall be interpreted as meaning free from dust and other material capable of being removed by use of reasonable effort and handheld broom.
3. In preparation for installation of succeeding materials, clean the structures or pertinent portions thereof to the degree of cleanliness recommended by the manufacturer of the succeeding material, using all equipment and materials required to achieve the required cleanliness.
4. Following the installation of finish floor materials, clean the finish floor daily while work is being performed in the space in which finish materials have been installed. "Clean" for the purposes of this subparagraph, shall be interpreted as meaning free from all foreign material which, in the opinion of the Construction Representative, may be injurious to the finish of the finish floor material.

### 3.2 FINAL CLEANING

- A. General: Provide final cleaning operations when indicated. Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit of Work to the condition expected from a commercial building cleaning and maintenance program. Comply with manufacturer's instructions.
- B. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for the entire Project or a portion of the Project.
  1. Clean the Project Site, yard and grounds, in areas disturbed by construction activities including landscape development areas, of rubbish, waste material, litter, and foreign substances.
  2. Sweep paved areas broom clean. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
  3. Remove petrochemical spills, stains, and other foreign deposits.
  4. Remove tools, construction equipment, machinery, and surplus material from the site.
  5. Remove snow and ice to provide safe access to the building.
  6. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
  7. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
  8. Broom clean concrete floors in unoccupied spaces.
  9. Vacuum clean carpet and similar soft surfaces removing debris and excess nap. Shampoo, if required.
  10. Clean transparent material, including mirrors and glass in doors and windows. Remove glazing compounds and other substances that are noticeable vision-

obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.

11. Remove labels that are not permanent labels.
  12. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
    - a. Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
  13. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
  14. Clean plumbing fixtures to a sanitary condition free of stains, including stains resulting from water exposure.
  15. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
  16. Clean ducts, blowers, and coils if units were operated without filters during construction
  17. Clean food-service equipment to a sanitary condition, ready and acceptable for its intended use.
  18. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs and defective and noisy starters in fluorescent and mercury vapor fixtures.
  19. Leave the Project clean and ready for occupancy.
- C. Pest Control: Engage an experienced, licensed exterminator to make a final inspection and rid the Project of rodents, insects, and other pests. Comply with regulations of local authorities.
- D. Removal of Protection: Remove temporary protection and facilities installed during construction to protect previously completed installations during the remainder of the construction period.
- E. Compliances: Comply with governing regulations and safety standards for cleaning operations. Remove waste materials from the site and dispose of lawfully.
1. Where extra materials of value remain after Final Acceptance by the Owner, they become the Owner's property.

**END OF SECTION 017400**

## **SECTION 017900 - DEMONSTRATION AND TRAINING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
  - 1. Demonstration of operation of systems, subsystems, and equipment.
  - 2. Training in operation and maintenance of systems, subsystems, and equipment.
  - 3. Demonstration and training video recordings.

#### **1.3 INFORMATIONAL SUBMITTALS**

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
- B. Attendance Record: For each training module, submit list of participants and length of instruction time.
- C. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

#### **1.4 CLOSEOUT SUBMITTALS**

- A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.
  - 1. Identification: On each copy, provide an applied label with the following information:
    - a. Name of Project.
    - b. Name and address of videographer.
    - c. Name of Architect.
    - d. Name of Construction Manager.
    - e. Name of Contractor.
    - f. Date of video recording.
  - 2. Transcript: Prepared in PDF electronic format. Include a cover sheet with same label information as the corresponding video recording and a table of contents with links to corresponding training components. Include name of Project and date of video recording on each page.

3. At completion of training, submit complete training manual(s) for Owner's use in PDF electronic file format on compact disc.

## **1.5 QUALITY ASSURANCE**

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative experienced in operation and maintenance procedures and training.
- C. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Coordination". Review methods and procedures related to demonstration and training including, but not limited to, the following:
  1. Inspect and discuss locations and other facilities required for instruction.
  2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
  3. Review required content of instruction.
  4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

## **1.6 COORDINATION**

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

## **PART 2 - PRODUCTS**

### **2.1 INSTRUCTION PROGRAM**

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
  1. Basis of System Design, Operational Requirements, and Criteria: Include the following:

- a. System, subsystem, and equipment descriptions.
  - b. Performance and design criteria if Contractor is delegated design responsibility.
  - c. Operating standards.
  - d. Regulatory requirements.
  - e. Equipment function.
  - f. Operating characteristics.
  - g. Limiting conditions.
  - h. Performance curves.
2. Documentation: Review the following items in detail:
- a. Emergency manuals.
  - b. Operations manuals.
  - c. Maintenance manuals.
  - d. Project record documents.
  - e. Identification systems.
  - f. Warranties and bonds.
  - g. Maintenance service agreements and similar continuing commitments.
3. Emergencies: Include the following, as applicable:
- a. Instructions on meaning of warnings, trouble indications, and error messages.
  - b. Instructions on stopping.
  - c. Shutdown instructions for each type of emergency.
  - d. Operating instructions for conditions outside of normal operating limits.
  - e. Sequences for electric or electronic systems.
  - f. Special operating instructions and procedures.
4. Operations: Include the following, as applicable:
- a. Startup procedures.
  - b. Equipment or system break-in procedures.
  - c. Routine and normal operating instructions.
  - d. Regulation and control procedures.
  - e. Control sequences.
  - f. Safety procedures.
  - g. Instructions on stopping.
  - h. Normal shutdown instructions.
  - i. Operating procedures for emergencies.
  - j. Operating procedures for system, subsystem, or equipment failure.
  - k. Seasonal and weekend operating instructions.
  - l. Required sequences for electric or electronic systems.
  - m. Special operating instructions and procedures.
5. Adjustments: Include the following:
- a. Alignments.
  - b. Checking adjustments.
  - c. Noise and vibration adjustments.
  - d. Economy and efficiency adjustments.



6. Troubleshooting: Include the following:
  - a. Diagnostic instructions.
  - b. Test and inspection procedures.
  
7. Maintenance: Include the following:
  - a. Inspection procedures.
  - b. Types of cleaning agents to be used and methods of cleaning.
  - c. List of cleaning agents and methods of cleaning detrimental to product.
  - d. Procedures for routine cleaning
  - e. Procedures for preventive maintenance.
  - f. Procedures for routine maintenance.
  - g. Instruction on use of special tools.
  
8. Repairs: Include the following:
  - a. Diagnosis instructions.
  - b. Repair instructions.
  - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
  - d. Instructions for identifying parts and components.
  - e. Review of spare parts needed for operation and maintenance.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 007213 "General Conditions".
- B. Set up instructional equipment at instruction location.

### **3.2 INSTRUCTION**

- A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
  1. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
  2. Owner will furnish an instructor to describe Owner's operational philosophy.
  3. Owner will furnish Contractor with names and positions of participants.
- B. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
  1. Schedule training with Owner with at least seven days' advance notice.

- C. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- D. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

### **3.3 DEMONSTRATION AND TRAINING VIDEO RECORDINGS**

- A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
  - 1. At beginning of each training module, record each chart containing learning objective and lesson outline.
- B. Video: Provide minimum 640 x 480 video resolution converted to format file type acceptable to Owner, on electronic media.
  - 1. Electronic Media: Read-only format compact disc acceptable to Owner, with commercial-grade graphic label.
  - 2. File Hierarchy: Organize folder structure and file locations according to project manual table of contents. Provide complete screen-based menu.
  - 3. File Names: Utilize file names based upon name of equipment generally described in video segment, as identified in Project specifications.
  - 4. Contractor and Installer Contact File: Using appropriate software, create a file for inclusion on the Equipment Demonstration and Training DVD that describes the following for each Contractor involved on the Project, arranged according to Project table of contents:
    - a. Name of Contractor/Installer.
    - b. Business address.
    - c. Business phone number.
    - d. Point of contact.
    - e. E-mail address.
- C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.
  - 1. Film training session(s) in segments not to exceed 15 minutes.
    - a. Produce segments to present a single significant piece of equipment per segment.
    - b. Organize segments with multiple pieces of equipment to follow order of Project Manual table of contents.
    - c. Where a training session on a particular piece of equipment exceeds 15 minutes, stop filming and pause training session. Begin training session again upon commencement of new filming segment.
- D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.

1. Furnish additional portable lighting as required.
- E. Narration: Describe scenes on video recording by audio narration by microphone while video recording is recorded. Include description of items being viewed.
- F. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.
- G. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

**END OF SECTION 017900**

## 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Testing, Adjusting, and Balancing of Air Systems:
    - a. Variable-air-volume systems.
  - 2. Testing, adjusting, and balancing of existing HVAC systems and equipment.

#### 1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report, as specified in Part 3.
- C. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures, as specified in "Preparation" Article.
- D. Examination Report: Submit a summary report of the examination review required in "Examination" Article.

- E. Certified TAB reports.
- F. Sample report forms.
- G. Instrument calibration reports, to include the following:
  - 1. Instrument type and make.
  - 2. Serial number.
  - 3. Application.
  - 4. Dates of use.
  - 5. Dates of calibration.

#### 1.5 QUALITY ASSURANCE

- A. TAB Specialists Qualifications, Certified by NEBB or AABC:
  - 1. TAB Technician: Employee of the TAB specialist and certified by AABC.
- B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
- C. Code and AHJ Compliance: TAB is required to comply with governing codes and requirements of authorities having jurisdiction.

#### 1.6 FIELD CONDITIONS

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

### PART 2 - EXECUTION

#### 2.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.
- B. Examine installed systems for balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine ceiling plenums and underfloor air plenums used for HVAC to verify that they are properly separated from adjacent areas and sealed.

- F. Examine equipment performance data, including fan and pump curves.
  - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
  - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.
- J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- K. Examine operating safety interlocks and controls on HVAC equipment.
- L. Examine control dampers for proper installation for their intended function of isolating, throttling, diverting, or mixing air flows.
- M. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

## 2.2 PREPARATION

- A. Prepare a TAB plan that includes the following:
  - 1. Equipment and systems to be tested.
  - 2. Strategies and step-by-step procedures for balancing the systems.
  - 3. Instrumentation to be used.
  - 4. Sample forms with specific identification for all equipment.
- B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
  - 1. Airside:
    - a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
    - b. Duct systems are complete with terminals installed.
    - c. Volume, smoke, and fire dampers are open and functional.
    - d. Clean filters are installed.

- e. Fans are operating, free of vibration, and rotating in correct direction.
- f. Variable-frequency controllers' startup is complete and safeties are verified.
- g. Automatic temperature-control systems are operational.
- h. Ceilings are installed.
- i. Windows and doors are installed.
- j. Suitable access to balancing devices and equipment is provided.

### 2.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system in accordance with the procedures contained in AABC's "National Standards for Total System Balance" and in this Section.
- B. Cut insulation, ducts, pipes, and equipment casings for installation of test probes to the minimum extent necessary for TAB procedures.
  - 1. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

### 2.4 TESTING, ADJUSTING, AND BALANCING OF HVAC EQUIPMENT

- A. Test, adjust, and balance HVAC equipment indicated on Drawings, including, but not limited to, the following:
  - 1. Fans and ventilators.
  - 2. Terminal units.
  - 3. Rooftop air-conditioning units.
  - 4. Dedicated outdoor-air units.

### 2.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' Record drawings duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling-unit components.

## 2.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. Adjust the variable-air-volume systems as follows:
  - 1. Verify that the system static pressure sensor is located two-thirds of the distance down the duct from the fan discharge.
  - 2. Verify that the system is under static pressure control.
  - 3. Select the terminal unit that is most critical to the supply-fan airflow. Measure inlet static pressure, and adjust system static pressure control set point so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
  - 4. Calibrate and balance each terminal unit for maximum and minimum design airflow as follows:
    - a. Adjust controls so that terminal is calling for maximum airflow. Some controllers require starting with minimum airflow. Verify calibration procedure for specific project.
    - b. Measure airflow and adjust calibration factor as required for design maximum airflow. Record calibration factor.
    - c. When maximum airflow is correct, balance the air outlets downstream from terminal units.
    - d. Adjust controls so that terminal is calling for minimum airflow.
    - e. Measure airflow and adjust calibration factor as required for design minimum airflow. Record calibration factor. If no minimum calibration is available, note any deviation from design airflow.
    - f. On constant volume terminals, in critical areas where room pressure is to be maintained, verify that the airflow remains constant over the full range of full cooling to full heating. Note any deviation from design airflow or room pressure.
  - 5. After terminals have been calibrated and balanced, test and adjust system for total airflow. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.
    - a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
    - b. Set terminals for maximum airflow. If system design includes diversity, adjust terminals for maximum and minimum airflow, so that connected total matches fan selection and simulates actual load in the building.



- c. Where duct conditions allow, measure airflow by main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses close to the fan and prior to any outlets, to obtain total airflow.
  - d. Where duct conditions are unsuitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
6. Measure fan static pressures as follows:
    - a. Measure static pressure directly at the fan outlet or through the flexible connection.
    - b. Measure static pressure directly at the fan inlet or through the flexible connection.
    - c. Measure static pressure across each component that makes up the air-handling system.
    - d. Report any artificial loading of filters at the time static pressures are measured.
  7. Set final return and outside airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
    - a. Balance the return-air ducts and inlets.
    - b. Verify that terminal units are meeting design airflow under system maximum flow.
  8. Re-measure the inlet static pressure at the most critical terminal unit, and adjust the system static pressure set point to the most energy-efficient set point to maintain the optimum system static pressure. Record set point and give to controls Contractor.
  9. Verify final system conditions as follows:
    - a. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.
    - b. Re-measure and confirm that total airflow is within design.
    - c. Re-measure final fan operating data, speed, volts, amps, and static profile.
    - d. Mark final settings.
    - e. Test system in economizer mode. Verify proper operation and adjust if necessary. Measure and record all operating data.
    - f. Verify tracking between supply and return fans.
  10. .

## 2.7 DUCT LEAKAGE TESTS

- A. Witness the duct leakage testing performed by Installer.
- B. Verify that proper test methods are used and that leakage rates are within specified limits.
- C. Report deficiencies observed.

## 2.8 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

- A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
  1. Measure and record the operating speed, airflow, and static pressure of each fan and equipment with fan(s).

2. Measure and record flows, temperatures, and pressures of each piece of equipment in each hydronic system. Compare the values to design or nameplate information, where information is available.
  3. Measure motor voltage and amperage. Compare the values to motor nameplate information.
  4. Check the refrigerant charge.
  5. Check the condition of filters.
  6. Check the condition of coils.
  7. Check the operation of the drain pan and condensate-drain trap.
  8. Check bearings and other lubricated parts for proper lubrication.
  9. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.
- B. TAB After Construction: Before performing testing and balancing of renovated existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished in accordance with renovation scope indicated by Contract Documents. Verify the following:
1. New filters are installed.
  2. Coils are clean and fins combed.
  3. Drain pans are clean.
  4. Fans are clean.
  5. Bearings and other parts are properly lubricated.
  6. Deficiencies noted in the preconstruction report are corrected.
- C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
  2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
  3. If calculations increase or decrease the airflow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
  4. Balance each air outlet.

## 2.9 TOLERANCES

- A. Set HVAC system's airflow rates and water flow rates within the following tolerances:
1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent If design value is less than 100 cfm, within 10 cfm.
  2. Air Outlets and Inlets: Plus or minus 10 percent. If design value is less than 100 cfm, within 10 cfm.
  - 3.
- B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

## 2.10 PROGRESS REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for system-balancing devices. Recommend changes and additions to system-balancing devices, to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance-measuring and -balancing devices.

## 2.11 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
  - 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
  - 2. Include a list of instruments used for procedures, along with proof of calibration.
  - 3. Certify validity and accuracy of field data.
- B. Final Report Contents: In addition to certified field-report data, include the following:
  - 1. Pump curves.
  - 2. Fan curves.
  - 3. Manufacturers' test data.
  - 4. Field test reports prepared by system and equipment installers.
  - 5. Other information relative to equipment performance; do not include Shop Drawings and Product Data.
- C. General Report Data: In addition to form titles and entries, include the following data:
  - 1. Title page.
  - 2. Name and address of the TAB specialist.
  - 3. Project name.
  - 4. Project location.
  - 5. Architect's name and address.
  - 6. Engineer's name and address.
  - 7. Contractor's name and address.
  - 8. Report date.
  - 9. Signature of TAB supervisor who certifies the report.
  - 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
  - 11. Summary of contents, including the following:
    - a. Indicated versus final performance.
    - b. Notable characteristics of systems.
    - c. Description of system operation sequence if it varies from the Contract Documents.
  - 12. Nomenclature sheets for each item of equipment.
  - 13. Data for terminal units, including manufacturer's name, type, size, and fittings.

14. Notes to explain why certain final data in the body of reports vary from indicated values.
  15. Test conditions for fans performance forms, including the following:
    - a. Settings for outdoor-, return-, and exhaust-air dampers.
    - b. Conditions of filters.
    - c. Cooling coil, wet- and dry-bulb conditions.
    - d. Heating coil, dry-bulb conditions.
    - e. Face and bypass damper settings at coils.
    - f. Fan drive settings, including settings and percentage of maximum pitch diameter.
    - g. Variable-frequency controller settings for variable-air-volume systems.
    - h. Settings for pressure controller(s).
    - i. Other system operating conditions that affect performance.
  16. Test conditions for pump performance forms, including the following:
    - a. Variable-frequency controller settings for variable-flow hydronic systems.
    - b. Settings for pressure controller(s).
    - c. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
  2. Water and steam flow rates.
  3. Duct, outlet, and inlet sizes.
  4. Pipe and valve sizes and locations.
  5. Terminal units.
  6. Balancing stations.
  7. Position of balancing devices.
- E. Air-Handling-Unit Test Reports: For air-handling units, include the following:
1. Unit Data:
    - a. Unit identification.
    - b. Location.
    - c. Make and type.
    - d. Model number and unit size.
    - e. Manufacturer's serial number.
    - f. Unit arrangement and class.
    - g. Discharge arrangement.
    - h. Sheave make, size in inches, and bore.
    - i. Center-to-center dimensions of sheave and amount of adjustments in inches.
    - j. Number, make, and size of belts.
    - k. Number, type, and size of filters.
  2. Motor Data:
    - a. Motor make, and frame type and size.
    - b. Horsepower and speed.
    - c. Volts, phase, and hertz.

- d. Full-load amperage and service factor.
  - e. Sheave make, size in inches, and bore.
  - f. Center-to-center dimensions of sheave and amount of adjustments in inches.
3. Test Data (Indicated and Actual Values):
- a. Total airflow rate in cfm.
  - b. Total system static pressure in inches wg.
  - c. Fan speed.
  - d. Inlet and discharge static pressure in inches wg.
  - e. For each filter bank, filter static-pressure differential in inches wg.
  - f. Preheat-coil static-pressure differential in inches wg.
  - g. Cooling-coil static-pressure differential in inches wg.
  - h. Heating-coil static-pressure differential in inches wg.
  - i. List for each internal component with pressure-drop, static-pressure differential in inches wg.
  - j. Outdoor airflow in cfm.
  - k. Return airflow in cfm.
  - l. Outdoor-air damper position.
  - m. Return-air damper position.

F. Apparatus-Coil Test Reports:

1. Coil Data:
- a. System identification.
  - b. Location.
  - c. Coil type.
  - d. Number of rows.
  - e. Fin spacing in fins per inch o.c.
  - f. Make and model number.
  - g. Face area in sq. ft..
  - h. Tube size in NPS.
  - i. Tube and fin materials.
  - j. Circuiting arrangement.
2. Test Data (Indicated and Actual Values):
- a. Airflow rate in cfm.
  - b. Average face velocity in fpm.
  - c. Air pressure drop in inches wg.
  - d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
  - e. Return-air, wet- and dry-bulb temperatures in deg F.
  - f. Entering-air, wet- and dry-bulb temperatures in deg F.
  - g. Leaving-air, wet- and dry-bulb temperatures in deg F.
3. Test Data (Indicated and Actual Values):
- a. Total airflow rate in cfm.
  - b. Entering-air temperature in deg F.

- c. Leaving-air temperature in deg F.
- d. Air temperature differential in deg F.
- e. Entering-air static pressure in inches wg.
- f. Leaving-air static pressure in inches wg.
- g. Air static-pressure differential in inches wg.
- h. Low-fire fuel input in Btu/h.
- i. High-fire fuel input in Btu/h.
- j. Manifold pressure in psig.
- k. High-temperature-limit setting in deg F.
- l. Operating set point in Btu/h.
- m. Motor voltage at each connection.
- n. Motor amperage for each phase.
- o. Heating value of fuel in Btu/h.

G. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:

- 1. Unit Data:
  - a. System identification.
  - b. Location.
  - c. Coil identification.
  - d. Capacity in Btu/h.
  - e. Number of stages.
  - f. Connected volts, phase, and hertz.
  - g. Rated amperage.
  - h. Airflow rate in cfm.
  - i. Face area in sq. ft..
  - j. Minimum face velocity in fpm.
- 2. Test Data (Indicated and Actual Values):
  - a. Heat output in Btu/h.
  - b. Airflow rate in cfm.
  - c. Air velocity in fpm.
  - d. Entering-air temperature in deg F.
  - e. Leaving-air temperature in deg F.
  - f. Voltage at each connection.
  - g. Amperage for each phase.

H. Fan Test Reports: For supply, return, and exhaust fans, include the following:

- 1. Fan Data:
  - a. System identification.
  - b. Location.
  - c. Make and type.
  - d. Model number and size.
  - e. Manufacturer's serial number.
  - f. Arrangement and class.
  - g. Sheave make, size in inches, and bore.

- h. Center-to-center dimensions of sheave and amount of adjustments in inches.
  - 2. Motor Data:
    - a. Motor make, and frame type and size.
    - b. Horsepower and speed.
    - c. Volts, phase, and hertz.
    - d. Full-load amperage and service factor.
    - e. Sheave make, size in inches, and bore.
    - f. Center-to-center dimensions of sheave and amount of adjustments in inches.
    - g. Number, make, and size of belts.
  - 3. Test Data (Indicated and Actual Values):
    - a. Total airflow rate in cfm.
    - b. Total system static pressure in inches wg.
    - c. Fan speed.
    - d. Discharge static pressure in inches wg.
    - e. Suction static pressure in inches wg.
- I. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
  - 1. Report Data:
    - a. System fan and air-handling-unit number.
    - b. Location and zone.
    - c. Traverse air temperature in deg F.
    - d. Duct static pressure in inches wg.
    - e. Duct size in inches.
    - f. Duct area in sq. ft..
    - g. Indicated airflow rate in cfm.
    - h. Indicated velocity in fpm.
    - i. Actual airflow rate in cfm.
    - j. Actual average velocity in fpm.
    - k. Barometric pressure in psig.
- J. Air-Terminal-Device Reports:
  - 1. Unit Data:
    - a. System and air-handling unit identification.
    - b. Location and zone.
    - c. Apparatus used for test.
    - d. Area served.
    - e. Make.
    - f. Number from system diagram.
    - g. Type and model number.
    - h. Size.
    - i. Effective area in sq. ft..

2. Test Data (Indicated and Actual Values):
  - a. Airflow rate in cfm.
  - b. Air velocity in fpm.
  - c. Preliminary airflow rate as needed in cfm.
  - d. Preliminary velocity as needed in fpm.
  - e. Final airflow rate in cfm.
  - f. Final velocity in fpm.
  - g. Space temperature in deg F.
  
- K. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
  1. Unit Data:
    - a. System and air-handling-unit identification.
    - b. Location and zone.
    - c. Room or riser served.
    - d. Coil make and size.
    - e. Flowmeter type.
  
  2. Test Data (Indicated and Actual Values):
    - a. Airflow rate in cfm.
    - b. Entering-water temperature in deg F.
    - c. Leaving-water temperature in deg F.
    - d. Water pressure drop in feet of head or psig.
    - e. Entering-air temperature in deg F.
    - f. Leaving-air temperature in deg F.
  
- L. Instrument Calibration Reports:
  1. Report Data:
    - a. Instrument type and make.
    - b. Serial number.
    - c. Application.
    - d. Dates of use.
    - e. Dates of calibration.

END OF SECTION 230593



## SECTION 230713 - DUCT INSULATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes insulating the following duct services:
  - 1. Indoor, concealed supply and outdoor air.
  - 2. Indoor, concealed return located in unconditioned space.
  - 3. Indoor, exposed supply air.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - 2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
  - 3. Detail application of field-applied jackets.

#### 1.3 COORDINATION

- A. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

#### 1.4 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.
  - 1. All Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

### 2.2 INSULATION MATERIALS

- A. Products do not contain asbestos, lead, mercury, or mercury compounds.
- B. Products that come in contact with stainless steel have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.
- C. Insulation materials for use on austenitic stainless steel are qualified as acceptable in accordance with ASTM C795.
- D. Foam insulation materials do not use CFC or HCFC blowing agents in the manufacturing process.
- E. Glass-Fiber Blanket: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 450 deg F in accordance with ASTM C411. Comply with ASTM C553, Type II, and ASTM C1290,

### 2.3 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
  - 1. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
  - 1. Verify that systems to be insulated have been tested and are free of defects.
  - 2. Verify that surfaces to be insulated are clean and dry.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

### 3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, compress, or otherwise damage insulation or jacket.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Keep insulation materials dry during application and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with Contract Documents
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth, but not to the extent of creating wrinkles or areas of compression in the insulation.

2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
  3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
    - a. For below ambient services, apply vapor-barrier mastic over staples.
  4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
  5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

### 3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
  4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
- E. Insulation Installation at Floor Penetrations:
  - 1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.

### 3.5 DUCT INSULATION DETAILS

- A. Insulation for indoor concealed rectangular and round ducts and plenums shall be Mineral-Fiber blanket, thick enough to achieve an installed R-value of 3.5 but not less than 1½-inches thick; and 1.5-lb/cu. ft. nominal density.
- B. Insulation for indoor exposed round ducts and plenums shall be Mineral-Fiber blanket, thick enough to achieve an installed R-value of 3.5 but not less than 1½-inches thick; and 1.5-lb/cu. ft. nominal density.
- C. Insulation for indoor exposed rectangular ducts and plenums shall be Mineral-Fiber board, thick enough to achieve an installed R-value of 3.5 but not less than 1½-inches thick; and 1.5-lb/cu. ft. nominal density.

END OF SECTION 230713

## SECTION 23 09 00 - CONTROL SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED SECTIONS

- A. Drawings and general provisions of Contract, including General and Special Conditions apply to work of this section.

#### 1.2 SUMMARY

- A. This section contains requirements for electric and digital control systems as indicated on the contract drawings.
  - 1. Contractor is responsible for providing, installing and connecting all DDC controllers, sensors, actuators, control valves, control dampers, electrical components and all interconnecting tubing and electrical wiring between these devices and up to the Direct Digital Controller (DDC).
  - 2. DDC controllers shall consist of Johnson Controls METASYS latest generation controllers, including type NAE, FEC, SNE, CGM, CVM, XPM, and VMA controllers, as applicable.
  - 3. After all equipment has been installed, wired and piped, Contractor will be responsible for all termination connections at the DDC controller's and for checking, testing, programming and start-up of the control system.
  - 4. Once each mechanical system is completely operational under the new control system, contractor shall make any final connections and adjustments.

#### 1.3 QUALITY ASSURANCE

- A. Contractor's Qualifications:
  - 1. Contractor shall be Johnson Controls – No Exceptions.
- B. Codes and Standards:
  - 1. Electrical Standards: Provide electrical components of control systems which have been UL-listed and labeled, and comply with NEMA standards.
  - 2. NEMA Compliance: Comply with NEMA standards pertaining to components and devices for control systems.
  - 3. NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" where applicable to controls and control sequences.

4. NFPA Compliance: Comply with NFPA 70 "National Electric Code".

1.4 COORDINATION

- A. Coordinate location of thermostats and other exposed control sensors with plans and room details before installation.
- B. Coordinate supply of conditioned electrical branch circuits for control units and operator workstation.
- C. Dedicated 20-amp / 120-volt AC Power circuit breakers are provided by Division 26 at Panel locations as shown on the Electrical Drawings. From that point, the party responsible for performance of this Section shall furnish, install, and connect all required power supply to all electric-powered control components furnished under this section. Furnish, install, and connect transformers as required to serve lower voltage and/or DC components furnished under this section. Perform field electrical work in complete and strict accordance with Division 26 requirements, the National Electric Code, and Part 3 of this Section.
- D. Coordinate equipment with Division 26 Section "Panelboards" to achieve compatibility with starter coils and annunciation devices.
- E. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."

1.5 CONNECTIVITY

- A. Controls associated with this project shall be connected to a remote existing campus building temperature control system, Johnson Controls "Metasys". It is essential that all components of the new controls system and any associated hardware for all systems specified interface seamlessly and are fully compatible with the existing campus BAS. New wiring, transmission systems, control panels, etc. shall not create interference or incompatibility with the existing campus system's circuitry and devices.

## 1.6 SUBMITTALS

- A. Shop Drawings: Submit shop drawings for each control system, containing the following information:
  - 1. Product data for each damper, valve, and control device.
  - 2. Schematic flow diagrams of system showing fans, pumps, coils, dampers, valves, and control devices.
  - 3. Label each control device with setting or adjustable range of control.
  - 4. Indicate all required electrical wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
  - 5. Provide details of faces on control panels, including controls, instruments, and labeling.
  - 6. Include written description of Sequence of Operation.
  - 7. Provide wiring diagrams of contractor provided interface and I/O panels.

## PART 2 - PRODUCTS

### 2.1 MATERIALS AND EQUIPMENT

- A. All components and equipment associated with this specification must be fully capable of communicating with and integrating with the campus Johnson Controls Metasys control system.
- B. DDC Equipment:
  - 1. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.
    - a. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation or diagnostic terminal unit.
    - b. Stand-alone mode control functions operate regardless of network status. Functions include the following:
      - 1) Global communications.
      - 2) Discrete/digital, analog, and pulse I/O.
      - 3) Monitoring, controlling, or addressing data points.
      - 4) Software applications, scheduling, and alarm processing.
      - 5) Testing and developing control algorithms without disrupting field hardware and controlled environment.
    - c. Standard Application Programs:



- 1) Coordinate first seven subparagraphs below with sequence of operation.
  - 2) Electric Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, night setback/setup, on-off control with differential sequencing, staggered start, anti-short cycling, PID control, DDC with fine tuning, and trend logging.
  - 3) HVAC Control Programs: Optimal run time, supply-air reset, and economizer switchover.
  - 4) Programming Application Features: Include trend point; alarm processing and messaging; weekly, monthly, and annual scheduling; energy calculations; run-time totalization; and security access.
  - 5) Remote communications.
  - 6) Maintenance management.
  - 7) Units of Measure: Inch-pound and SI (metric).
- d. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
  - e. ASHRAE 135 Compliance: Control units shall use ASHRAE 135-2020 BACnet protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.
2. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.
    - a. Units monitor or control each I/O point, process information, and download from or upload to operator workstation or diagnostic terminal unit.
    - b. Stand-alone mode control functions operate regardless of network status. Functions include the following:
      - 1) Global communications.
      - 2) Discrete/digital, analog, and pulse I/O.
      - 3) Monitoring, controlling, or addressing data points.
    - c. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
    - d. ASHRAE 135 Compliance: Control units shall use ASHRAE 135-2020 BACnet protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.
3. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.
  4. Binary Inputs: Allow monitoring of on-off signals without external power.
  5. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
  6. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
  7. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation with three-position (on-off-auto) override switches and status lights.
  8. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA) with status lights.

9. Tri-State Outputs: Provide two coordinated binary outputs for control of three-point, floating-type electronic actuators.

10. Universal I/Os: Provide software selectable binary or analog outputs.

C. Unitary Controllers:

1. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.

a. Configuration: Local keypad and display; diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and 72-hour battery backup.

b. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. Perform automatic system diagnostics; monitor system and report failures.

c. ASHRAE 135 Compliance: Communicate using read (execute and initiate) and write (execute and initiate) property services defined in ASHRAE 135-2020. Reside on network using MS/TP and IP datalink/physical layer protocol and have service communication port for connection to diagnostic terminal unit

d. Enclosure: Dustproof rated for operation at 32 to 120°F (0 to 50°C).

D. Conduit and Raceway:

1. Electrical Metallic Tubing: EMT and fittings shall conform to ANSI C80.3.

2. Surface Metal Raceway and Fittings: Wiremold 500, Ivory, or approved equal.

3. Flexible Metal Conduit: Indoors, per National Electric Code for connection to moving or vibrating equipment.

4. Liquidtight Flexible Conduit: Outdoors, per National Electric Code for connection to moving or vibrating equipment.

E. Resistance Temperature Sensors and Transmitters (Air and Water Electronic Temperature Sensors).

1. All electric temperature sensors shall be compatible with Johnson METSYS systems.

a. Accuracy: Plus or minus 0.2 percent at calibration point.

- b. Wire: Twisted, shielded-pair cable.
  - c. Insertion Elements in Ducts: Use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft.
  - d. Averaging Elements in Ducts: Use where prone to temperature stratification or where ducts are larger than 9 sq. ft., length as required.
  - e. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2½-inches.
  - f. Space Temperature Sensors: Mount beneath a thermostat cover with thermometer and local setpoint adjustment. Provide cast aluminum guards on space temperature sensors located in public areas.
  - g. Water sensor and water well: TE-63AM-2 (Platinum) water sensor with TE-6300W-102 (SS) water well.
  - h. Air sensor: TE6300 series (Nickel).
- F. Occupant Override: Provide wall mounted occupant override button in locations shown on drawings.
- G. Fan/Pump Status: Status points for fan or pump motors with a VFD must be connected to the terminal strip of the VFD for status indication.
- 1. Current switches: Current switches are required for fan and pump statuses that are not connected to a VFD. The switches must have an adjustable trip setpoint with LED indication and be capable of detecting broken belts or couplings. Units shall be powered by monitored line, UL listed and CE certified, and have a five year warranty.
    - a. Kele, Hawkeye or approved equal.
- H. Pressure Differential Switch:
- 1. Fans: NECC model DP222 or approved equal.
  - 1. Differential Pressure Transmitter: Provide units with linear analog 4-20mA output proportional to differential pressure, compatible with the Johnson METASYS Systems.
    - 1. Air: Units shall be capable of measuring a differential pressure of 0 to 5 in. WC. Accuracy shall be +/- 1.0% full scale with a compensated temperature range of 40 to 149 deg. F and a maximum working pressure of 250 psig.
      - a. Setra model 267, or approved equal.
      - b. Shall be installed in control panel and piped 2/3 down the duct unless shown otherwise or approved by owners representative.
- J. Building Static Pressure: Transducer shall utilize a ceramic capacitive sensing element to provide a stable linear output over the specified range of building static pressure. Transducer shall be housed in a wall-mounted enclosure with LCD display. Transducer shall have the following capabilities:
- 1. Input Power: 24 VAC
  - 2. Output: 0-10 VDC

3. Pressure Range: -0.25 to +0.25 inches w.g.
  4. Display: 3-1/2 digit LCD, displaying pressure in inches w.g.
  5. Accuracy: +/- 1.0% combined linearity and hysteresis
  6. Temperature effect: 0.05% / deg C
  7. Zero drift (1 year): 2.0% max
  8. Zero adjust: Push-button auto-zero and digital input
  9. Operating Environment: 0 to 140 deg F, 90% RH (non-condensing)
  10. Fittings: Brass barbs, 1/8" O.D.
  11. Enclosure: High-impact ABS plastic
  12. Outdoor Sensing Tube Enclosure: UV stabilized thermoplastic or aluminum "can" enclosure to shield outdoor pressure sensing tube from wind effects.
  13. Transducer shall be Veris Industries Model PXPLX01S, equivalent from Setra, or approved equal
- K. High (Low) Static Pressure Limit Switch: Provide pressure high (low) limit switch to open contact in fan circuit to shut down the supply fan when the static pressure rises above the set point (drops below set point for low static pressure limit switch). Provide with an adjustable set point, a manual reset button, 2 SPST (normally closed) contacts, and ¼ inch compression fittings.
1. Kele model AFS-460-DDS, or approved equal.
- L. Humidity Sensors: Bulk polymer sensor element.
1. Accuracy: 2 percent full range with linear output.
  2. Room Sensor Range: 20 to 80 percent relative humidity.
  3. Room Sensor Cover Construction: Manufacturer's standard locking covers.
  4. Duct Sensor: 20 to 100 percent relative humidity range with element guard and mounting plate.

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF CONTROL SYSTEMS

- A. General: Install systems and materials in accordance with manufacturer's instructions, roughing-in drawings and details shown on drawings.

- B. Raceway: Raceway is to be installed in accordance with the National Electric Code. Use of flexible metal conduit or liquidtight flexible conduit is limited to 36 inches to connect from EMT to devices subject to movement. Flexible raceway is not to be used to compensate for misalignment of raceway during installation.
- C. Control Wiring: Install control wiring in raceway, without splices between terminal points, color-coded. Install in a neat workmanlike manner, securely fastened. Install in accordance with National Electrical Code.
1. Install circuits over 25-volt with color-coded No. 12 stranded wire.
  2. Install electronic circuits and circuits under 25-volts with color-coded No. 18 stranded twisted shielded pair type conductor.
  3. N2 communications bus wire shall be 18 AWG, plenum rated, stranded twisted shielded, 3 conductor, with blue outer casing, described as 18-03 OAS STR PLNM NEON BLU JK distributed by Windy City Wire, constructed by Cable-Tek, or approved equivalent.
  4. FC communications bus wire shall be 22 AWG, plenum rated, stranded twisted shielded, 3 conductor, with blue outer casing, described as 22-03 OAS STR PLNM NEON BLU JK distributed by Windy City Wire, constructed by Cable-Tek, or approved equivalent.
  5. Metastat wiring shall be minimum 20 AWG, plenum rated, stranded, 8 conductor stranded wire.
  6. All control wiring at control panel shall be tagged and labeled during installation to assist owner in making termination connections at control panel. Label all control wires per bid documents.
- D. All low voltage electrical wiring shall be run as follows:
1. Route electrical wiring in concealed spaces and mechanical rooms whenever possible.
  2. Provide EMT conduit and fittings in mechanical rooms and where indicated on drawings.
  3. Low voltage electrical wiring routed above acoustical ceiling is not required to be in conduit, but wire must be plenum rated. Clip wire to structural ceiling.
  4. Provide surface raceway, fittings and boxes in finished areas where wiring cannot be run in concealed spaces. Route on ceiling or along walls as close to ceiling as possible. Run raceway parallel to walls. Diagonal runs are not permitted. Paint raceway and fittings to match existing conditions. Patch/repair/paint any exposed wall penetrations to match existing conditions.
- E. All devices shall be mounted appropriately for the intended service and location.
1. Wall mounted sensors and thermostats shall be provided with base and covers in occupied areas and mounted 4 feet 6 inches above finished floor. Tubing and/or wiring shall be concealed within the wall up to the ceiling where ever possible. Surface raceway may only be used with approval of Owner's Representative.
  2. Duct mounted sensors shall be provided with mounting brackets to accommodate insulation.

Mounting clips for capillary tubes for averaging sensors are required.

3. All control devices shall be tagged and labeled for future identification and servicing of control system.
- F. Install magnehelic pressure gage across each air handling unit filter bank. If the air handling unit has a prefilter and a final filter, two magnehelic pressure gages are required.
- G. All meters installed 7 feet above finished floor shall have a remote reader installed in a location satisfactory to the Owner.

### **3.2 ADJUSTING AND START-UP**

- A. Refer to Division 01, Section "Commissioning" for detailed requirements for commissioning responsibilities and activities.

### **3.3 CLOSEOUT PROCEDURES**

- A. Contractor shall provide complete diagrams of the control system including flow diagrams with each control device labeled, a diagram showing the termination connections, and an explanation of the control sequence. The diagram and sequence shall be framed and protected by glass and mounted next to controller.

END OF SECTION 230900

## SECTION 233113 - METAL DUCTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.

##### B. Related Requirements:

1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

#### 1.2 ACTION SUBMITTALS

##### A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.
3. Seismic-restraint devices.

##### B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top and bottom of ducts.
5. Dimensions of all duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

- C. Delegated Design Submittals:
  - 1. Sheet metal thicknesses.
  - 2. Joint and seam construction and sealing.
  - 3. Reinforcement details and spacing.
  - 4. Materials, fabrication, assembly, and spacing of hangers and supports.
  - 5.

### 1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: A single set of plans or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and with performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports and seismic restraints are to withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and ASCE/SEI 7. Seismically brace duct hangers and supports in accordance with SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."
- C. Airstream Surfaces: Surfaces in contact with airstream comply with requirements in ASHRAE 62.1.
- D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Startup."
- E. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."
- F. Duct Dimensions: Unless otherwise indicated, all duct dimensions indicated on Drawings are inside clear dimensions and do not include insulation or duct wall thickness.

### 2.2 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
  - 1. Construct ducts of galvanized sheet steel unless otherwise indicated.



- B. Transverse Joints: Fabricate joints in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 1. For ducts with longest side less than 24", select joint types in accordance with Figure 2-1.
  - 2. For ducts with longest side 24" or greater, use flange joint connector Type T-25a, or T-25b. Factory-fabricated flanged duct connection system may be used if submitted and approved by engineer of record.
- C. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible." All longitudinal seams are to be Pittsburgh lock seams unless otherwise specified for specific application.
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

### 2.3 SINGLE-WALL ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
  - 1. Construct ducts of galvanized sheet steel unless otherwise indicated.
- B. Source Limitations: Obtain single-wall round ducts and fittings from single manufacturer.
- C. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).
- D. Transverse Joints: Select joint types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- E. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- F. Tees and Laterals: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and

Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

## 2.4 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets are to be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
- B. Water-Based Joint and Seam Sealant:
  - 1. Application Method: Brush on.
  - 2. Solids Content: Minimum 65 percent.
  - 3. Shore A Hardness: Minimum 20.
  - 4. Water resistant.
  - 5. Mold and mildew resistant.
  - 6. VOC: Maximum 75 g/L (less water).
  - 7. Maximum Static-Pressure Class: 6inch wg, positive and negative.
  - 8. Service: Indoor or outdoor.
  - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

## 2.5 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Galvanized-steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A603.
- E. Steel Cables for Stainless Steel Ducts: Stainless steel complying with ASTM A492.
- F. Steel Cable End Connections: Galvanized-steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
  - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

## PART 3 - EXECUTION

### 3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and coordination drawings.
- B. Install ducts in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install ducts in maximum practical lengths with fewest possible joints.
- D. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- G. Install ducts with a clearance of 1" inch, plus allowance for insulation thickness.
- H. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- I. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- J. Install fire and smoke dampers where indicated on Drawings and as required by code, and by local authorities having jurisdiction. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers and specific installation requirements of the damper UL listing.
- K. Install heating coils, cooling coils, air filters, dampers, and all other duct-mounted accessories in air ducts where indicated on Drawings.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials both before and after installation.
- M. Elbows: Use long-radius elbows wherever they fit.
  - 1. Fabricate 90-degree rectangular mitered elbows to include turning vanes.
  - 2. Fabricate 90-degree round elbows with a minimum of three segments
- N. Branch Connections: Use lateral or conical branch connections.

### 3.2 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Seal ducts at a minimum to the following seal classes in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
  - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 2. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
  - 3. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
  - 4. Unconditioned Space, Return-Air Ducts: Seal Class B.

### 3.3 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
  - 1. Where practical, install concrete inserts before placing concrete.
  - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
  - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

### 3.4 DUCTWORK CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."

- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

### 3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.

### 3.6 STARTUP

- A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

### 3.7 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

- 1. Fabricate all ducts to achieve SMACNA pressure class, seal class, and leakage class as indicated below.

- B. Supply Ducts:

- 1. Ducts Connected to Variable-Air-Volume Air-Handling Units Upstream of VAV Boxes.

- a. Pressure Class: 4”.
- b. Minimum SMACNA Seal Class: **A**

- 2. Ducts Connected Downstream of VAV Boxes.

- a. Pressure Class: Positive **2”**
- b. Minimum SMACNA Seal Class: **B**.

- C. Elbow Configuration:

- 1. Rectangular Duct - Requirements for Different Velocities: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

- a. Velocity 1000 fpm or Lower:

- 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
- 2) Mitered Type RE 4 without vanes.

- b. Velocity 1000 to 1500 fpm:

- 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
- 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.

- 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
- c. Velocity 1500 fpm or Higher:
- 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
  - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
  - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
2. Rectangular Duct - Requirements for All Velocities: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
- a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
  - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
  - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
- a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
    - 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
    - 2) Velocity 1000 to 1500 fpm 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
    - 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
    - 4) Radius-to Diameter Ratio: 1.5.
  - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
  - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.
- D. Branch Configuration:
1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
    - a. Rectangular Main to Rectangular Branch: 45-degree entry.
    - b. Rectangular Main to Round Branch: Conical spin in.

2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
  - a. Velocity 1000 fpm or Lower: 90-degree tap.
  - b. Velocity 1000 to 1500 fpm: Conical tap.
  - c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 233113

## SECTION 233300 – DUCT ACCESSORIES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:

1. Manual volume dampers.
2. Fire dampers.
3. Turning vanes.
4. Duct-mounted access doors.
5. Flexible connectors.
6. Flexible ducts.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.
- C. Room-by-Room Listing: For constant airflow regulators as specified herein, submit room-by-room listing for entire project that indicates model number of constant airflow regulator proposed, airflow in CFM and associated room number.

#### 1.4 QUALITY ASSURANCE

- A. Comply with NFPA 90A, “Installation of Air Conditioning and Ventilating Systems.”
- B. Comply with AMCA 500-D testing for damper rating.

#### 1.5 REFERENCED STANDARDS

- A. Sheet Metal and Air Conditioning Contractors’ National Association. *HVAC Duct Construction Standards – Metal and Flexible*. 3rd ed. Chantilly, VA: SMACNA, 2005.



## 1.6 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Fusible Links: Furnish quantity equal to 10 percent of amount installed, but not less than two (2).

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. HVAC Dampers (all types):
    - a. Greenheck Inc.
    - b. Nailor Industries Inc.
    - c. Ruskin Company.
  - 2. Turning Vanes:
    - a. Ductmate Industries, Inc.
    - b. Duro Dyne Inc.
    - c. Metalaire, Inc.
    - d. Semco Incorporated.
  - 3. Duct-Mounted Access Doors:
    - a. American Warming and Ventilating; a division of Mestek, Inc.
    - b. Cesco Products; a division of Mestek, Inc.
    - c. Ductmate Industries, Inc.
    - d. Flexmaster U.S.A., Inc.
    - e. Greenheck Fan Corporation.
    - f. McGill AirFlow LLC.
    - g. Nailor Industries Inc.
    - h. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

- i. Ruskin Company.
- 4. Flexible Connectors:
  - a. Ductmate Industries, Inc.
  - b. Duro Dyne Inc.
  - c. Ventfabrics, Inc.
- 5. Flexible Ducts:
  - a. Type 8B by Flexmaster USA, Inc.
  - b. “M-KE” by ThermaFlex.
- 6. Air Flow Regulator
  - a. American ALDES Ventilation Corporation, Bradenton, Florida.
  - b. United Enertech

## 2.2 MATERIALS

- A. Comply with SMACNA’s “HVAC Duct Construction Standards – Metal and Flexible” for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A653/A653M and having G90 (Z275) coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.
- C. Stainless-Steel Sheets: Comply with ASTM A480/A480M, Type 304, and having a No. 2D finish for concealed ducts and No. 4 finish for exposed ducts.
- D. Aluminum Sheets: Comply with ASTM B209 (ASTM B209M), Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- E. Extruded Aluminum: Comply with ASTM B221 (ASTM B221M), Alloy 6063, Temper T6.
- F. Minimum Thickness: All sheet steel used on this project shall be a minimum of 24-gage thickness, and all aluminum sheets shall be a minimum of 0.04-inch thickness, regardless of whether or not SMACNA standards permit thinner gage material.
- G. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- H. Tie Rods: Comply with Articles 2.5 through 2.9, including all accompanying Tables and Figures, of the SMANCA HVAC Duct Construction Standards.

## 2.3 MANUAL VOLUME DAMPERS

- A. Manual volume dampers shall be standard leakage rating, with linkage outside airstream, suitable for horizontal or vertical applications. Volume dampers may be factory-manufactured or contractor-fabricated per SMACNA Fig. 7-4/7-5.
- B. Material: Match material options throughout this subsection to the material of adjacent ductwork. For duct material, refer to Division 23 Section "Metal Ducts."
- C. Frames: Hat-shaped channels with mitered and welded corners, flanges for attaching to walls, and flangeless frames for installing in ducts.
  - 1. Galvanized-steel, 16-gage or 0.064-inch (1.62-mm) minimum thickness, for use in galvanized steel ducts.
  - 2. Aluminum sheet, 12-gage or 0.100-inch- (2.5-mm-) minimum thickness, for use in aluminum ducts.
  - 3. Stainless-steel, 16-gage or 0.064-inch (1.62-mm) minimum thickness, for use in stainless steel ducts.
- D. Blades: Multiple-blade; single-blade if duct dimension is 12-inch or less in the direction perpendicular to damper axis. Parallel or opposed-blade design (contractor's choice, unless a specific type is indicated). Stiffen damper blades for stability.
  - 1. Galvanized-steel, 16-gage or 0.064-inch (1.62 mm) thick, for use in galvanized steel ducts.
  - 2. Roll-Formed Aluminum, 12-gage or 0.10-inch- (2.5-mm-) thick aluminum sheet, for use in aluminum ducts.
  - 3. Stainless-steel, 16-gage or 0.064-inch (1.62 mm) thick, for use in stainless steel ducts.
- E. Blade Axles: Galvanized steel, aluminum, or stainless steel, as required to match blade material. Dampers shall have axles full length of damper blades, and bearings at both ends of operating shaft.
- F. Bearings: Oil-impregnated bronze, molded synthetic, and stainless-steel sleeve-type are acceptable.
- G. Tie Bars and Brackets: Galvanized steel or aluminum.
- H. Jackshaft:
  - 1. Size: 1-inch (25-mm) diameter.
  - 2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
  - 3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.
- I. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- (2.4-mm-) thick zinc-plated steel, and a 3/4-inch (19-mm) hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.
4. For all insulated ductwork, provide extended shaft parts and kit to extend handle through insulation. Provide Ruskin crank arms, extended shaft and hand quadrant (ESK050, ESK050B or approved equal). Damper shaft and handle shall be completely insulated. Refer to Division 23 “Mechanical Insulation.”

## 2.4 FIRE DAMPERS

- A. Type: Dynamic; rated and labeled according to UL 555 (2002 Edition). Label according to UL 555C if used in a rated ceiling application.
- B. Closing rating in ducts up to 4-inch wg (1-kPa) static pressure class and 2000-fpm (10-m/s) velocity.
- C. Fire Rating: 1½ hours.
- D. Frame: SMACNA Type A, B or C as indicated; fabricated with roll-formed, 20-gage galvanized steel; with mitered and interlocking corners. If no indication is given, use Frame Type B for rectangular ducts and Frame Type C for round ducts.
- E. Mounting Orientation: Vertical or horizontal as indicated.
- F. Blades: Roll-formed, interlocking, galvanized sheet steel.
- G. Horizontal Dampers: Include blade lock and stainless-steel negator closure spring.
- H. Single-use Fusible Link: Replaceable, 165°F (74 C) rated, fusible links.
- I. Mounting Sleeve: Factory-supplied, factory or field-installed, galvanized sheet steel sleeve; length as indicated. Include factory-supplied, field-installed two-piece “picture-frame” mounting angles with pre-punched fastener holes.
  1. Factory Insulation: If used on a duct which requires thermal insulation per Division 23 Section “Mechanical Insulation,” then provide fire damper sleeve with factory thermal insulation. Damper/sleeve assembly with thermal insulation shall be listed and labeled according to UL555.
  2. Direct Grille Mounts: Where specifically indicated, furnish integral factory sleeve/mounting angle assembly UL-listed for direct grille attachment.
  3. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.

- J. Multiple-Section Assembly: Where indicated fire damper size exceeds the maximum UL-approved dimensions of the manufacturer's UL-listed product line, provide multiple-section dampers including mullions and other hardware necessary for a UL-approved multi-section fire damper assembly.

## 2.5 TURNING VANES

- A. Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- B. Contractor-Fabricated to comply with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible," Figures 4-3 and 4-4 single thickness type, or Contractor may elect to provide manufactured turning vanes as described below.
  - 1. Manufactured Turning Vanes: Fabricate of 1½-inch- (38-mm-) wide, curved blades set ¾-inch (19 mm) o.c.; support with bars perpendicular to blades set 2-inches (50 mm) o.c.; and set into side strips suitable for mounting in ducts.
  - 2. Double-thickness turning vanes will also be acceptable.

## 2.6 DUCT-MOUNTED ACCESS DOORS

- A. Duct-Mounted Access Doors: Factory-manufactured doors, airtight and suitable for duct pressure class.
- B. Door: Double wall, rectangular, galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
- C. Insulation: 1-inch (25-mm-) thick, fibrous-glass or polystyrene-foam board.
- D. Hinges and Latches: 1-by-1-inch (25-by-25-mm) butt or piano hinge and cam latches.
- E. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.
- F. Number of Hinges and Locks: Two hinges, or continuous piano hinge, and two sash locks.

## 2.7 FLEXIBLE CONNECTORS

- A. Materials: Flame-retardant or noncombustible fabrics.
- B. Coatings and Adhesives: Comply with UL 181, Class 1.
- C. Metal-Edged Connectors: Factory fabricated with a fabric strip 5¾-inches (146 mm) wide attached to 2 strips of 2¾-inch- (70-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized sheet steel or 0.032-inch- (0.8-mm-) thick aluminum sheets. Provide metal compatible with connected ducts.
- D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene or polychloroprene.

1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).
  2. Tensile Strength: 480 lbf/inch (84 N/mm) in the warp and 360 lbf/inch (63 N/mm) in the filling.
  3. Service Temperature: Minus 40 to plus 200°F (Minus 40 to plus 93 C).
- E. Thrust Limits: As specified in Division 23 Section “Mechanical Vibration Isolation.”

## 2.8 FLEXIBLE DUCTS

- A. General: Comply with UL 181, Class 1. Factory-fabricated, insulated, round duct, with an outer jacket enclosing glass-fiber insulation around a continuous inner liner.
1. Reinforcement: Galvanized steel wire helix encapsulated in inner liner.
  2. Outer Jacket: Polyethylene vapor-barrier film.
  3. Inner Liner: CPE film, acoustically transparent to mid-range sound energy.
- B. Required Pressure Ratings:
1. Sizes 12-inch and smaller: At least 8-inch wg positive.
  2. Sizes larger than 12-inch: At least 4-inch wg positive.
  3. Burst Rating: 2.5 times working pressure rating above.
- C. Velocity Rating: 4000 fpm.
- D. Temperature Rating: -20°F to +250°F.
- E. Thermal Rating: Minimum R-4.2 thermal resistance.
- F. Flexible Duct Connector Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 through 18-inches, to suit duct size.
- G. Provide flexible ducts with Flexflow elbow by Thermaflex for connections to air devices.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA’s “HVAC Duct Construction Standards – Metal and Flexible.”
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

- C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts.
  - 1. Locate dampers at least two duct diameters from fittings and as far away as possible from outlets.
  - 2. Install steel volume dampers in steel ducts.
  - 3. Install aluminum volume dampers in aluminum ducts.
  - 4. Install stainless steel volume dampers in stainless steel ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install fire dampers, smoke dampers, and fire/smoke dampers according to UL listing.
- H. Install duct silencers rigidly to ducts.
- I. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
  - 1. Adjacent to and close enough to fire dampers, to reset or reinstall fusible links.
  - 2. Downstream of in-duct coils.
  - 3. Adjacent to duct mounted air flow regulator to allow for inspection and removal.
  - 4. Elsewhere as indicated.
  - 5. Upstream of all airflow measuring stations.
- J. Install access doors with swing against duct static pressure.
- K. Access Door Size: 18 by 10-inches (460 by 250 mm) unless noted otherwise
- L. Label access doors according to Division 23 Section “Basic Mechanical Materials and Methods” to indicate the purpose of access door.
- M. Label fire dampers, combination fire and smoke dampers and smoke dampers according to Division 23 Section “Basic Mechanical Materials and Methods” to indicate the location of each damper.
- N. Install flexible connectors to connect ducts to equipment.
- O. For fans developing static pressures of 5-inch wg (1250 Pa) and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

- P. Connect air devices to ducts with flexible duct clamped or strapped in place.
- Q. Install flexible ducts in accordance with the following:
1. Turn radius of flexible duct at duct centerline shall not exceed one times nominal duct diameter.
  2. At least one support shall be installed for every run of flexible duct that is 60-inches (1500 mm) long or longer; more if needed to comply with next paragraph.
  3. Support flexible duct so that it does not contact nor rest upon light fixtures, sprinkler and other piping, ceilings and ceiling hanger wires, electrical conduits and cable tray, and similar items.
  4. All supporting material surfaces in direct contact with supported flexible duct shall maintain a minimum of one-inch in contact width along full length of contact.
  5. Comply with Figures 3-10 and 3-11 in SMACNA's *HVAC Duct Construction Standards – Metal and Flexible*. 3rd ed. except where more stringent details are given on the Drawings.
  6. Comply with Specifications 3.5, 3.6, and 3.7, paragraphs S3.19 through S3.40, of SMACNA's *HVAC Duct Construction Standards – Metal and Flexible*. 3rd ed., except where more stringent requirements are specified herein.
  7. Flexible ductwork shall not be used on ducted return or exhaust systems.
- R. Install duct test holes where required for testing and balancing purposes.
- S. Connect air devices to ducts directly or with a minimum 36-inch (900-mm) and a maximum 72-inch (1800-mm) length of flexible duct clamped or strapped in place.
- T. Install air flow regulator in rigid ducts, duct collar or register boxes without the use of screws or any other mechanical device. The perimeter gasket provides a seal to grip the interior of the duct in which the unit is installed. Unit may be installed in vertical or horizontal ducting. When installed in horizontal ducting the unit must be installed with base downward. Install units in accordance with all applicable building and mechanical codes. If installed in a metal duct or duct collar with flexible duct connector the regulator must be inserted at least 0.7 times the duct diameter from the flexible duct and/or duct connector.
- U. Install a manual balancing damper upstream of all air terminal units (FTU and VAV) at the branch take-off for pressure reduction.
- V. Install a manual balancing damper upstream of all diffusers, grilles and registers, even if just one diffuser, for possible future balancing needs or control stability. Autoflow regulators shall be installed in place of manual balancing damper in all outside supply air and exhaust air served by energy recovery units.

### 3.2 FIELD QUALITY CONTROL

#### A. Tests and Inspections:

1. Inspect locations of access doors and verify that purpose of access door can be performed.



2. Operate fire dampers to verify full range of movement and verify that proper heat-response device is installed.
3. Inspect turning vanes for proper and secure installation.

END OF SECTION 233300

## SECTION 23 33 46 – FLEXIBLE DUCTS

### GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Insulated flexible ducts.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For flexible ducts.
  - 1. Include plans showing locations and mounting and attachment details.

### PART 2 - PRODUCTS

#### 2.1 ASSEMBLY DESCRIPTION

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- C. Comply with the Air Diffusion Council's "ADC Flexible Air Duct Test Code FD 72-R1."
- D. Comply with ASTM E96/E96M, "Test Methods for Water Vapor Transmission of Materials."

#### 2.2 INSULATED FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Flexmaster U.S.A., Inc.
  - 2. Thermaflex; a Flex-Tek Group company.

- B. Insulated, Flexible Duct: UL 181, Class 1, polyethylene supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.
  - 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
  - 2. Maximum Air Velocity: 4000 fpm.
  - 3. Temperature Range: Minus 10 to plus 160 deg F.
  - 4. Insulation R-Value: R4.2.

### 2.3 FLEXIBLE DUCT CONNECTORS

- A. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install flexible ducts according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install in indoor applications only. Flexible ductwork should not be exposed to UV lighting.
- C. Connect diffusers or light troffer boots to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- D. Connect flexible ducts to metal ducts with stainless steel band clamps.
- E. Install duct test holes where required for testing and balancing purposes.
  - 1. Install ducts fully extended.
  - 2. Do not bend ducts across sharp corners.
  - 3. Bends of flexible ducting shall not exceed a minimum of one duct diameter.
  - 4. Avoid contact with metal fixtures, water lines, pipes, or conduits.
  - 5. Install flexible ducts in a direct line, without sags, twists, or turns.
- F. Supporting Flexible Ducts:
  - 1. Suspend flexible ducts with bands 1-1/2 inches wide or wider and spaced a maximum of 48 inches apart. Maximum centerline sag between supports shall not exceed 1/2 inch per 12 inches.
  - 2. Install extra supports at bends placed approximately one duct diameter from center line of the bend.
  - 3. Ducts may rest on ceiling joists or truss supports. Spacing between supports shall not exceed the maximum spacing per manufacturer's written installation instructions.
  - 4. Vertically installed ducts shall be stabilized by support straps at a maximum of 72 inches o.c.

END OF SECTION 233346

## SECTION 23 36 00 – AIR TERMINAL UNITS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Variable Volume Unit
- B. Related sections include Division 23 Section “Control Systems” for control devices and installation associated with air terminals.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated, include rated capacities; furnished specialties and accessories; shipping, installed, and operating weights; and sound-power ratings for each model indicated. Detail equipment assemblies and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection. Include a schedule showing unique model designation, room location, model number, size, and accessories furnished.
- B. Shop Drawings: For air terminal units. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
- C. Wiring Diagrams: Detail wiring for power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.
- D. Coordination Drawings: Refer to Division 23 Section “Basic Mechanical Requirements.”
- E. Operation and Maintenance Data

#### 1.4 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of air terminal units and are based on the specific system indicated. Refer to Division 23 Section “Basic Mechanical Requirements.”

- B. NFPA Compliance: Install air terminal units according to NFPA 90A, “Standard for the Installation of Air Conditioning and Ventilating Systems.”
- C. AHRI Certification: Only air terminals that are certified under the AHRI Standard 880 Certification Program and carry the AHRI Seal will be accepted.
- D. ASHRAE Compliance: Meet applicable requirements in ASHRAE 62.1-2019, Section 5 – “Systems and Equipment” and Section 7 – “Construction and System Start-Up.”

## **1.5 COORDINATION**

- A. Coordinate layout and installation of air terminal units and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide Air Terminal Units by one of the following:
  - 1. Price Industries; E.H. Price Co.
  - 2. Titus.
  - 3. Tuttle & Bailey, div. of Hart & Cooley, Inc.

### **2.2 AIR TERMINAL UNITS, GENERAL**

- A. Configuration: Pressure independent terminal unit as scheduled; including volume-damper assembly inside unit casing with control components located inside a protective metal shroud. Unit sizes, capacities, maximum and minimum airflows, maximum noise ratings, and maximum air pressure drops shall be as scheduled on the Drawings.
- B. Casing: Unit casing shall be welded, galvanized steel. Leak rate shall be no more than 1% of rated capacity at 4” wg. Interior surface of unit casing shall be acoustically and thermally lined with ½”, minimum 1.5lb/cu ft. Density glass fiber with foil face. Insulation shall be UL listed and meet NFPA-90A and UL181
- C. Factory mounted removable panel on bottom of unit providing access to air valve and entering airside of coil.
- D. Straight flange or slip and drive rectangular discharge duct connection.
- E. Minimum 22-gage steel or 0.032-inch (0.8-mm) aluminum.

- F. Air valve shall be a 90° rotational damper flow control device with factory installed direct digital controls (DDC). All controls shall be furnished by controls contractor and mounted and wired in the factory by unit manufacturer. Manufacturer shall provide multiple point averaging flow sensing ring with high and low pressure pneumatic tubes compatible with DDC velocity pressure sensor. A calibration chart shall be provided on each unit.
- G. At the contractor's option temperature controls contractor may field mount controls at no additional cost to the owner.
- H. Units shall be manufactured by Price, Envirotec, JCI, Titus or Tuttle and Bailey.

### **2.3 ELECTRIC REHEAT COILS**

- A. Electric reheat coils shall be SCR controlled open-coil design.
- B. Electric reheat coils shall be of the size and voltage listed on the drawings and be provided with factory installed disconnect switch.
- C. Units shall be Price, Envirotec, JCI, Titus, or Tuttle and Bailey

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install air terminal units level and plumb, according to manufacturer's written instructions, rough-in drawings, original design, and referenced standards. Maintain sufficient clearance for normal service and maintenance.
- B. Protect all openings of air terminal units with filters or temporary covers throughout project storage, handling, and placement, to keep clean the interiors of air terminal units.
- C. Terminal units shall be continuously insulated with thermal insulation and vapor barrier, in unbroken path from inlet duct through to outlet duct, so that no bare metal surfaces are left uninsulated. Field-insulate any portions of terminal unit if not factory-insulated, including but not limited to heating coil casing and duct inlet collar. Field insulation and vapor barrier are specified in Division 23 Section "Mechanical Insulation."

### **3.2 HANGER AND SUPPORT INSTALLATION**

- A. Comply with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible," Chapter 4, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
  - 1. Where practical, install concrete inserts before placing concrete.

2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes and for slabs more than 4 inches (100 mm) thick.
  4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes and for slabs less than 4 inches (100 mm) thick.
- C. Hangers Exposed to View: Threaded rod and angle or channel supports.
- D. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

### **3.3 CONNECTIONS**

- A. Ductwork: Connect ductwork to air terminals according to Division 23 ductwork Sections and Details on Drawings.
- B. Hot Water Piping: Connect heating coils Install piping adjacent to air terminal units to allow service and maintenance. Piping installation requirements are specified Division 23 Section “Hydronic Piping.” Drawings indicate general arrangement of piping, fittings, and specialties.
- C. Controls: Field-installed controls specified herein shall be installed and connected as the work of Division 23 Section “Controls.”

### **3.4 IDENTIFICATION**

- A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Division 23 Section “Basic Mechanical Materials and Methods” for equipment labels and warning signs and labels.

### **3.5 FIELD QUALITY CONTROL**

- A. Complete installation and startup checks according to manufacturer’s written instructions, and perform the following field tests and inspections:
1. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
  2. Verify that controls and control enclosure are accessible.
  3. Verify that control connections are complete.
  4. Verify that nameplate and identification tag are visible.
  5. Verify that controls respond to inputs as specified.
  6. After installing air terminal units, and after electrical circuitry (where applicable) has been

energized, test for compliance with requirements.

7. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
  8. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  9. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Remove and replace malfunctioning units and retest as specified above.

### **3.6 CLEANING**

- A. After completing system installation, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes.

END OF SECTION 233600



## SECTION 23 37 13 AIR DIFFUSERS

### GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Rectangular and square ceiling diffusers.
2. Louver face diffusers.
3. Linear slot diffusers.

B. Related Requirements:

1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

### PART 2 - PRODUCTS

#### 2.1 RECTANGULAR AND SQUARE CEILING DIFFUSERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. METALAIRE, Inc.
2. Price Industries Limited.
3. Titus; brand of Johnson Controls International plc, Global Products.

B. Devices shall be specifically designed for variable-air-volume flows.

C. Material: Steel

D. Finish: Baked enamel, white

E. Face Size: 24 by 24 inches.

F. Mounting: T-bar.

G. Pattern: **Fixed**.

## 2.2 LOUVER FACE DIFFUSERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Price Industries Limited.
  2. Titus; brand of Johnson Controls International plc, Global Products.
  3. METALAIRE, Inc.
- B. Devices shall be specifically designed for variable-air-volume flows.
- C. Material: Steel
- D. Finish: Baked enamel, white.
- E. Mounting: T-bar.

## 2.3 LINEAR SLOT DIFFUSERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Price Industries Limited.
  2. Titus; brand of Johnson Controls International plc, Global Products.
  3. METALAIRE, Inc.
- B. Devices shall be specifically designed for variable-air-volume flows.
- C. Material - Shell: Steel insulated.
- D. Material - Pattern Controller and Tees: Aluminum.
- E. Finish - Face and Shell: Baked enamel, white .

## 2.4 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas where diffusers are installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install diffusers level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

### 3.3 ADJUSTING

- A. After installation, adjust diffusers to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

## SECTION 237416.13 - PACKAGED, LARGE-CAPACITY, ROOFTOP AIR-CONDITIONING UNITS

### PART 1 - GENERAL

#### 1.01 GENERAL DESCRIPTION

- A. This section includes the design, controls and installation requirements for packaged rooftop units / outdoor air handling units.

#### 1.02 QUALITY ASSURANCE

- A. Unit shall be certified in accordance with UL Standard 1995/CSA C22.2 No. 236, Safety Standard for Heating and Cooling Equipment.
- B. RTU-1, RTU-2, DOAS-1 Unit and refrigeration system shall comply with ASHRAE 15, Safety Standard for Mechanical Refrigeration.
- C. RTU-1, RTU-2, DOAS-1 Unit Energy Efficiency Ratio (EER) shall be equal to or greater than that prescribed by ASHRAE 90.1, Energy Efficient Design of New Buildings except Low-Rise Residential Buildings.
- D. RTU-1, RTU-2, DOAS-1 Unit shall be safety certified by ETL and ETL US listed. Unit nameplate shall include the ETL/ETL Canada label.

#### 1.03 SUBMITTALS

- A. Product Data: Literature shall be provided that indicates dimensions, operating and shipping weights, capacities, ratings, fan performance, filter information, factory supplied accessories, electrical characteristics and connection requirements. Installation, Operation, and Maintenance manual with startup requirements shall be provided.
- B. Shop Drawings: Unit drawings shall be provided that indicate assembly, unit dimensions, construction details, clearances and connection details. Computer generated fan curves for each fan shall be submitted with specific design operation point noted. Wiring diagram shall be provided with details for both power and control systems and differentiate between factory installed and field installed wiring.

#### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. Unit shall be shipped with doors screwed shut and outside air hood closed to prevent damage during transport and thereafter while in storage awaiting installation.
- B. Follow Installation, Operation, and Maintenance manual instructions for rigging, moving, and unloading the unit at its final location.
- C. Unit shall be stored in a clean, dry place protected from construction traffic in accordance with the Installation, Operation, and Maintenance manual.

#### 1.05 WARRANTY

- A. RTU-1, RTU-2, DOAS-1 Manufacturer shall provide a limited "parts and labor" warranty for a period of 12 months from the date of equipment startup or 18 months from the date of

original equipment shipment from the factory, whichever is less. In addition Manufacturer shall provide a limited “compressor parts only” warranty for a period of 60 months from the date of equipment startup. Warranty shall cover material and workmanship that prove defective, within the specified warranty period, provided manufacturer’s written instructions for Installation, Operation, and maintenance have been followed. Warranty excludes parts associated with routine maintenance, such as belts and filters.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURER

- A. Products shall be provided by the following manufacturers:
1. AAON
  2. Pre-bid Approved equal from Daikin
  3. Pre-bid Approved equal from Trane
    - a. RTU-1, RTU-2, DOAS-1 R-410A refrigerant
    - b. RTU-1, RTU-2, DOAS-1 Variable capacity compressor with 10-100% capacity control
    - c. Direct drive supply fans
    - d. Double wall cabinet construction
    - e. Insulation with a minimum R-value of 13
    - f. RTU-1, RTU-2, DOAS-1 Stainless steel drain pans

### 2.02 ROOFTOP UNITS

- A. General Description
1. RTU-1, RTU-2, DOAS-1 Packaged rooftop unit shall include gas heat, compressors, evaporator coils, filters, supply fans, dampers, air-cooled condenser coils, condenser fans, reheat coil, exhaust fans, and unit controls.
  2. Unit shall be factory assembled and tested including leak testing of the DX coils, pressure testing of the refrigeration circuit, and run testing of the completed unit. Run test report shall be supplied with the unit in the service compartment’s literature pocket.
  3. Unit shall have decals and tags to indicate lifting and rigging, service areas and caution areas for safety and to assist service personnel.
  4. Unit components shall be labeled, including refrigeration system components, and electrical and controls components.
  5. Estimated sound power levels (dB) shall be shown on the unit ratings sheet.
  6. Installation, Operation, and Maintenance manual shall be supplied within the unit.
  7. Laminated color-coded wiring diagram shall match factory installed wiring and shall be

affixed to the interior of the control compartment's hinged access door.

8. Unit nameplate shall be provided in two locations on the unit, affixed to the exterior of the unit and affixed to the interior of the control compartment's hinged access door.

B. Construction

1. All cabinet walls, access doors, and roof shall be fabricated of double wall, impact resistant, rigid polyurethane foam panels.
2. Unit insulation shall have a minimum thermal resistance R-value of 13. Foam insulation shall have a minimum density of 2 pounds/cubic foot and shall be tested in accordance with ASTM D1929-11 for a minimum flash ignition temperature of 610°F.
3. Unit construction shall be double wall with G90 galvanized steel on both sides and a thermal break.
4. Unit shall be designed to reduce air leakage and infiltration through the cabinet. Cabinet leakage shall not exceed 1% of total airflow when tested at 3 times the minimum external static pressure provided in AHRI Standard 340/360. Panel deflection shall not exceed L/240 ratio at 125% of design static pressure, at a maximum 8 inches of positive or negative static pressure, to reduce air leakage. Deflection shall be measured at the midpoint of the panel height and width. Continuous sealing shall be included between panels and between access doors and openings to reduce air leakage. Piping and electrical conduit through cabinet panels shall include sealing to reduce air leakage.
5. Roof of the air tunnel shall be sloped to provide complete drainage. Cabinet shall have rain break overhangs above access doors.
6. All Units - Access to filters, dampers, cooling coils, reheat coil, heaters, compressors, and electrical and controls components shall be through hinged access doors with quarter turn, zinc cast, lockable handles. Full length stainless steel piano hinges shall be included on the doors.
7. Exterior paint finish shall be capable of withstanding at least 2,500 hours, with no visible corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B 117-95 test procedure.
8. Units with cooling coils shall include double sloped 304 stainless steel drain pans.
9. RTU-1, RTU-2, Unit shall be provided with base discharge and return air openings. All openings through the base pan of the unit shall have upturned flanges of at least 1/2 inch in height around the opening.
10. Unit shall include lifting lugs on the top of the unit.

C. Electrical (All Units)

1. Unit shall have a 35kAIC SCCR and a factory wired circuit breaker.
2. Unit shall be provided with a factory installed and factory wired 115V, 12 amp GFI outlet disconnect switch in the unit control panel.
3. Unit shall be provided with phase and brown out protection which shuts down all

motors in the unit if the electrical phases are more than 10% out of balance on voltage, the voltage is more than 10% under design voltage or on phase reversal.

D. Supply Fans (All Units)

1. Unit shall include direct drive, unhooded, backward curved, plenum supply fans.
2. Blowers and motors shall be dynamically balance and mounted on rubber isolators.
3. Motors shall be premium efficiency ODP with ball bearings rated for 200,000 hours service with external lubrication points.
4. Variable frequency drives shall be factory wired and mounted in the unit. Fan motors shall be premium efficiency.

E. Exhaust Fans (RTU-1, RTU-2)

1. Exhaust dampers shall be sized for 100% relief.
2. Fans and motors shall be dynamically balanced.
3. Unit shall include barometric relief dampers.
4. Motors shall be premium efficiency ODP with ball bearings rated for 200,000 hours service with external lubrication points.
5. Access to exhaust fans shall be through double wall, hinged access doors with quarter turn lockable handles.
6. Unit shall include belt driven, unhooded, backward curved, plenum exhaust fans.
7. Variable frequency drives shall be factory wired and mounted in the unit. Fan motors shall be premium efficiency.

F. Cooling Coils (All Units)

1. Evaporator Coils
  - a. Coils shall be designed for use with R-410A refrigerant and constructed of copper tubes with aluminum fins mechanically bonded to the tubes and galvanized steel end casings. Fin design shall be sine wave rippled.
  - b. Coils shall have interlaced circuitry and shall be standard capacity.
  - c. Coils shall be hydrogen or helium leak tested.
  - d. Coils shall be furnished with factory installed expansion valves.

G. Refrigeration System (All Units)

1. Unit shall be factory charged with R-410A refrigerant.
2. Compressors shall be scroll type with thermal overload protection and carry a 5 year non-prorated warranty, from the date of original equipment shipment from the factory.
3. Compressors shall be mounted in an isolated service compartment which can be

accessed without affecting unit operation. Lockable hinged compressor access doors shall be fabricated of double wall, rigid polyurethane foam injected panels to prevent the transmission of noise outside the cabinet.

4. Compressors shall be isolated from the base pan with the compressor manufacturer's recommended rubber vibration isolators, to reduce any transmission of noise from the compressors into the building area.
5. Each refrigeration circuit shall be equipped with expansion valve type refrigerant flow control.
6. Each refrigeration circuit shall be equipped with automatic reset low pressure and manual reset high pressure refrigerant safety controls, Schrader type service fittings on both the high pressure and low pressure sides and a factory installed liquid line filter driers.
7. Unit shall include a variable capacity scroll compressor on the lead refrigeration circuit which shall be capable of modulation from 10-100% of its capacity.
8. DOAS-1 Lead refrigeration circuit shall be provided with hot gas reheat coil, modulating valves, electronic controller, supply air temperature sensor and a control signal terminal which allow the unit to have a dehumidification mode of operation, which includes supply air temperature control to prevent supply air temperature swings and overcooling of the space.
9. Unit shall be configured as an air-source heat pump. Each refrigeration circuit shall be equipped with a factory installed liquid line filter drier with check valve, reversing valve, accumulator, and expansion valves on both the indoor and outdoor coils. Reversing valve shall energize during the heat pump cooling mode of operation.
10. Each refrigeration circuit shall be equipped with a liquid line sight glass.
11. Each refrigeration circuit shall be equipped with suction and discharge compressor isolation valves.
12. The factory installed controls shall include a 3 minute off delay timer to prevent compressor short cycling. The controls shall also include an adjustable, 20 second delay timer for each additional capacity stage to prevent multiple capacity stages from starting simultaneously and adjustable compressor lock out.

#### H. Condensers (All Units)

1. Air-Cooled Condenser
  - a. Condenser fans shall be a vertical discharge, axial flow, direct drive fans.
  - b. Heat pump outdoor coil shall be constructed of copper tubes with aluminum fins mechanically bonded to the tubes and aluminum end casings. Fin design shall be sine wave rippled.
  - c. Coils shall be designed for a minimum of 10°F of refrigerant sub-cooling.
  - d. Coils shall be hydrogen or helium leak tested.



- e. Condenser fans shall be high efficiency electrically commutated motor driven with factory installed head pressure control module. Condenser airflow shall continuously modulate based on head pressure and cooling operation shall be allowed down to 35°F with adjustable compressor lockout.
- I. Gas Heat
- a. Unit shall include natural gas fired gas heat.
  - b. DOAS – Stainless Steel Heat Exchanger capable of 8 to 1 turn-down.
  - c. RTU-1 and RTU-2 Alumized Heat Exchanger 3 to 1 turndown.
- J. Filters (all Units)
- 1. Unit shall include 2 inch thick, pleated panel filters with an ASHRAE MERV rating of 8, and a 4” thick pleated panel filter with an Merv rating of 11 upstream of the cooling coil.
- L. Outside Air/Economizer
- 1. RTU-1, RTU-2, Unit shall include 0-100% economizer consisting of a motor operated outside air damper and return air damper assembly constructed of extruded aluminum, hollow core, airfoil blades with rubber edge seals and aluminum end seals. Damper blades shall be gear driven and designed to have no more than 20 cfm of leakage per sq ft. at 4 in. w.g. air pressure differential across the damper. Low leakage dampers shall be Class 2 AMCA certified, in accordance with AMCA Standard 511. Damper assembly shall be controlled by spring return enthalpy activated fully modulating actuator. Unit shall include outside air opening bird screen, outside air hood, and relief dampers.
  - 2. DOAS-1 Unit shall include 100% motor operated outside air damper assembly constructed of extruded aluminum, hollow core, airfoil blades with rubber edge and end seals. Damper blades shall be gear driven and designed to have no more than 20 cfm of leakage per sq ft. at 4 in. w.g. air pressure differential across the damper. Low leakage dampers shall be Class 2 AMCA certified, in accordance with AMCA Standard 511. Damper assembly shall be controlled by spring return, 2 position actuator. Unit shall include outside air opening bird screen and outside air hood.
- M. Controls (All Units)
- 1. Factory Installed and Factory Provided Controller
    - a. Unit controller shall be capable of controlling all features and options of the unit. Controller shall be factory installed in the unit controls compartment and factory tested. Controller shall be capable of standalone operation with unit configuration, setpoint adjustment, sensor status viewing, unit alarm viewing, and occupancy scheduling available without dependence on a building management system.
    - b. Controller shall have an onboard clock and calendar functions that allow for occupancy scheduling.

- c. Controller shall include non-volatile memory to retain all programmed values without the use of a battery, in the event of a power failure.
- d. RTU-1, RTU-2, Variable Volume Controller
  - 1. RTU-1, RTU-2, Unit shall modulate cooling with variable airflow to meet space temperature cooling loads.
  - 2. RTU-1, RTU-2, Unit shall modulate heating with variable airflow to meet space temperature heating loads. Staged heating capacity shall modulate based on space temperature.
- e. DOAS-1 Makeup Air Controller
  - 1. DOAS-1 Unit shall modulate cooling with constant airflow to meet ventilation outside air loads. Cooling capacity shall modulate based on supply air temperature.
  - 2. DOAS-1 With modulating hot gas reheat, unit shall modulate cooling and hot gas reheat as efficiently as possible, to meet outside air humidity loads and prevent supply air temperature swings and overcooling of the space.
- f. RTU-1, RTU-2, DOAS-1 Unit configuration, setpoint adjustment, sensor status viewing, unit alarm viewing, and occupancy scheduling shall be accomplished with connection to interface module with LCD screen and input keypad, interface module with touch screen, or with connection to PC with free configuration software. Controller shall be capable of connection with other factory installed and factory provided unit controllers with individual unit configuration, setpoint adjustment, sensor status viewing, and occupancy scheduling available from a single unit. Connection between unit controllers shall be with a modular cable. Controller shall be capable of communicating and integrating with a BACnet network.

N. Accessories (All Units)

- 1. Unit shall be provided with a safety shutdown terminal block for field installation of a smoke detector which shuts off the unit's control circuit.

2.03 CURBS

- A. Curbs shall to be fully gasketed between the curb top and unit bottom with the curb providing full perimeter support, cross structure support and air seal for the unit.
- B. DOAS-1 Knockdown curb (with duct support rails and seismic clips) shall be factory furnished for field assembly.
- C. RTU-1, RTU-2 Provide adapter curb with seismic clips. Curb shall be watertight & include Minimum R-12 deck pan and curb side insulation.

PART 3 - EXECUTION

3.01 INSTALLATION, OPERATION, AND MAINTENANCE

- A. Installation, Operation, and Maintenance manual shall be supplied with the unit.
- B. Installing contractor shall install unit, including field installed components, in accordance with Installation, Operation, and Maintenance manual instructions.
- C. Start up and maintenance requirements shall be complied with to ensure safe and correct operation of the unit.

## SECTION 260010 - SUPPLEMENTAL REQUIREMENTS FOR ELECTRICAL

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Supplemental requirements generally applicable to the Work specified in Division 26. This Section is also referenced by related Work specified in other Divisions.

##### B. Related Requirements:

1. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

#### 1.2 REFERENCES

##### A. Abbreviations and Acronyms for Electrical Terms and Units of Measure:

1. 8P8C: An 8-position 8-contact modular jack.
2. A: Ampere, unit of electrical current.
3. AC or ac: Alternating current.
4. AFCI: Arc-fault circuit interrupter.
5. AIC: Ampere interrupting capacity.
6. AL, Al, or ALUM: Aluminum.
7. ASD: Adjustable-speed drive.
8. ATS: Automatic transfer switch.
9. AWG: American wire gauge; see ASTM B258.
10. BAS: Building automation system.
11. BIL: Basic impulse insulation level.
12. BIM: Building information modeling.
13. CAD: Computer-aided design or drafting.
14. CATV: Community antenna television.
15. CB: Circuit breaker.
16. cd: Candela, the SI fundamental unit of luminous intensity.
17. CO/ALR: Copper-aluminum, revised.
18. COPS: Critical operations power system.
19. CU or Cu: Copper.
20. CU-AL or AL-CU: Copper-aluminum.
21. dB: Decibel, a unitless logarithmic ratio of two electrical, acoustical, or optical power values.
22. dB(A-weighted) or dB(A): Decibel acoustical sound pressure level with A-weighting applied in accordance with IEC 61672-1.
23. dB(adjusted) or dBa: Decibel weighted absolute noise power with respect to 3.16 pW (minus 85 dBm).

24. dBm: Decibel absolute power with respect to 1 mW.
25. DC or dc: Direct current.
26. DCOA: Designated critical operations area.
27. DDC: Direct digital control (HVAC).
28. EGC: Equipment grounding conductor.
29. ELV: Extra-low voltage.
30. EMF: Electromotive force.
31. EMI: Electromagnetic interference.
32. EPM: Electrical preventive maintenance.
33. EPS: Emergency power supply.
34. EPSS: Emergency power supply system.
35. ESS: Energy storage system.
36. EV: Electric vehicle.
37. EVPE: Electric vehicle power export equipment.
38. EVSE: Electric vehicle supply equipment.
39. fc: Footcandle, an internationally recognized unit of illuminance equal to one lumen per square foot or 10.76 lx. The simplified conversion  $1 \text{ fc} = 10 \text{ lx}$  in the Specifications is common practice and considered adequate precision for building construction activities. When there are conflicts, lux is the primary unit; footcandle is specified for convenience.
40. FLC: Full-load current.
41. ft: Foot.
42. ft-cd: Foot-candle, the antiquated U.S. Standard unit of illuminance, equal to one international candle measured at a distance of one foot, that was superseded in 1948 by the unit "footcandle" after the SI unit candela (cd) replaced the international candle; see "fc,"
43. GEC: Grounding electrode conductor.
44. GFCI: Ground-fault circuit interrupter.
45. GFPE: Ground-fault protection of equipment.
46. GND: Ground.
47. HACR: Heating, air conditioning, and refrigeration.
48. HDPE: High-density polyethylene.
49. HID: High-intensity discharge.
50. HP or hp: Horsepower.
51. HVAC: Heating, ventilating, and air conditioning.
52. Hz: Hertz.
53. IBT: Intersystem bonding termination.
54. inch: Inch. To avoid confusion, the abbreviation "in." is not used.
55. IP: Ingress protection rating (enclosures); Internet protocol (communications).
56. IR: Infrared.
57. IS: Intrinsically safe.
58. IT&R: Inspecting, testing, and repair.
59. ITE: Information technology equipment.
60. kAIC: Kiloampere interrupting capacity.
61. kcmil or MCM: One thousand circular mils.
62. kV: Kilovolt.
63. kVA: Kilovolt-ampere.
64. kVA<sub>r</sub> or kVAR: Kilovolt-ampere reactive.
65. kW: Kilowatt.
66. kWh: Kilowatt-hour.
67. LAN: Local area network.
68. lb: Pound (weight).

69. lbf: Pound (force).
70. LCD: Liquid-crystal display.
71. LCDI: Leakage-current detector-interrupter.
72. LED: Light-emitting diode.
73. Li-ion: Lithium-ion.
74. lm: Lumen, the SI derived unit of luminous flux.
75. LNG: Liquefied natural gas.
76. LP-Gas: Liquefied petroleum gas.
77. LRC: Locked-rotor current.
78. LV: Low voltage.
79. lx: Lux, the SI derived unit of illuminance equal to one lumen per square meter.
80. m: Meter.
81. MCC: Motor-control center.
82. MDC: Modular data center.
83. MG set: Motor-generator set.
84. MIDI: Musical instrument digital interface.
85. MLO: Main lugs only.
86. MV: Medium voltage.
87. MVA: Megavolt-ampere.
88. mW: Milliwatt.
89. MW: Megawatt.
90. MWh: Megawatt-hour.
91. NC: Normally closed.
92. Ni-Cd: Nickel-cadmium.
93. Ni-MH: Nickel-metal hydride.
94. NIU: Network interface unit.
95. NO: Normally open.
96. NPT: National (American) standard pipe taper.
97. OCPD: Overcurrent protective device.
98. ONT: Optical network terminal.
99. PC: Personal computer.
100. PCS: Power conversion system.
101. PCU: Power-conditioning unit.
102. PF or pf: Power factor.
103. PHEV: Plug-in hybrid electric vehicle.
104. PLC: Programmable logic controller.
105. PLFA: Power-limited fire alarm.
106. PoE: Power over Ethernet.
107. PV: Photovoltaic.
108. PVC: Polyvinyl chloride.
109. pW: Picowatt.
110. RFI: (electrical) Radio-frequency interference; (contract) Request for interpretation.
111. RMS or rms: Root-mean-square.
112. RPM or rpm: Revolutions per minute.
113. SCADA: Supervisory control and data acquisition.
114. SCR: Silicon-controlled rectifier.
115. SPD: Surge protective device.
116. sq.: Square.
117. SWD: Switching duty.
118. TCP/IP: Transmission control protocol/Internet protocol.
119. TEFC: Totally enclosed fan-cooled.

120. TR: Tamper resistant.
121. TVSS: Transient voltage surge suppressor.
122. UL: (standards) Underwriters Laboratories, Inc.; (product categories) UL, LLC.
123. UL CCN: UL Category Control Number.
124. UPS: Uninterruptible power supply.
125. USB: Universal serial bus.
126. UV: Ultraviolet.
127. V: Volt, unit of electromotive force.
128. V(ac): Volt, alternating current.
129. V(dc): Volt, direct current.
130. VA: Volt-ampere, unit of complex electrical power.
131. VAR: Volt-ampere reactive, unit of reactive electrical power.
132. VFC: Variable-frequency controller.
133. VOM: Volt-ohm-multimeter.
134. VPN: Virtual private network.
135. VRLA: Valve regulated lead acid; also called "sealed lead acid (SLA)" or "valve regulated sealed lead acid."
136. W: Watt, unit of real electrical power.
137. Wh: Watt-hour, unit of electrical energy usage.
138. WPT: Wireless power transfer.
139. WPTE: Wireless power transfer equipment.
140. WR: Weather resistant.

B. Abbreviations and Acronyms for Electrical Raceway Types:

1. EMT: Electrical metallic tubing.
2. EMT-A: Aluminum electrical metallic tubing.
3. EMT-S: Steel electrical metallic tubing.
4. EMT-SS: Stainless steel electrical metallic tubing.
5. ENT: Electrical nonmetallic tubing.
6. EPEC: Electrical HDPE underground conduit (thin wall).
7. EPEC-A: Type A electrical HDPE underground conduit.
8. EPEC-B: Type B electrical HDPE underground conduit.
9. ERMC: Electrical rigid metal conduit.
10. ERMC-A: Aluminum electrical rigid metal conduit.
11. ERMC-S: Steel electrical rigid metal conduit.
12. ERMC-S-G: Galvanized-steel electrical rigid metal conduit.
13. ERMC-S-PVC: PVC-coated-steel electrical rigid metal conduit.
14. ERMC-SS: Stainless steel electrical rigid metal conduit.
15. FMC: Flexible metal conduit.
16. FMC-A: Aluminum flexible metal conduit.
17. FMC-S: Steel flexible metal conduit.
18. FMT: Steel flexible metallic tubing.
19. FNMC: Flexible nonmetallic conduit. See "LFNC."
20. HDPE: HDPE underground conduit (thick wall).
21. HDPE-40: Schedule 40 HDPE underground conduit.
22. HDPE-80: Schedule 80 HDPE underground conduit.
23. IMC: Steel electrical intermediate metal conduit.
24. LFMC: Liquidtight flexible metal conduit.
25. LFMC-A: Aluminum liquidtight flexible metal conduit.
26. LFMC-S: Steel liquidtight flexible metal conduit.

27. LFMC-SS: Stainless steel liquidtight flexible metal conduit.
28. LFNC: Liquidtight flexible nonmetallic conduit.
29. LFNC-A: Layered (Type A) liquidtight flexible nonmetallic conduit.
30. LFNC-B: Integral (Type B) liquidtight flexible nonmetallic conduit.
31. LFNC-C: Corrugated (Type C) liquidtight flexible nonmetallic conduit.
32. PVC: Rigid PVC conduit.
33. PVC-40: Schedule 40 rigid PVC conduit.
34. PVC-80: Schedule 80 rigid PVC Conduit.
35. PVC-A: Type A rigid PVC concrete-encased conduit.
36. PVC-EB: Type EB rigid PVC concrete-encased underground conduit.
37. RGS: See ERM-C-S-G.
38. RMC: See ERM-C.
39. RTRC: Reinforced thermosetting resin conduit.
40. RTRC-AG: Low-halogen, aboveground reinforced thermosetting resin conduit.
41. RTRC-AG-HW: Heavy wall, low-halogen, aboveground reinforced thermosetting resin conduit.
42. RTRC-AG-SW: Standard wall, low-halogen, aboveground reinforced thermosetting resin conduit.
43. RTRC-AG-XW: Extra heavy wall, low-halogen, aboveground reinforced thermosetting resin conduit.
44. RTRC-BG: Low-halogen, belowground reinforced thermosetting resin conduit.

C. Abbreviations and Acronyms for Electrical Single-Conductor and Multiple-Conductor Cable Types:

1. AC: Armored cable.
2. CATV: Coaxial general-purpose cable.
3. CATVP: Coaxial plenum cable.
4. CATVR: Coaxial riser cable.
5. CI: Circuit integrity cable.
6. CL2: Class 2 cable.
7. CL2P: Class 2 plenum cable.
8. CL2R: Class 2 riser cable.
9. CL2X: Class 2 cable, limited use.
10. CL3: Class 3 cable.
11. CL3P: Class 3 plenum cable.
12. CL3R: Class 3 riser cable.
13. CL3X: Class 3 cable, limited use.
14. CM: Communications general-purpose cable.
15. CMG: Communications general-purpose cable.
16. CMP: Communications plenum cable.
17. CMR: Communications riser cable.
18. CMUC: Under-carpet communications wire and cable.
19. CMX: Communications cable, limited use.
20. DG: Distributed generation cable.
21. FC: Flat cable.
22. FCC: Flat conductor cable.
23. FPL: Power-limited fire-alarm cable.
24. FPLP: Power-limited fire-alarm plenum cable.
25. FPLR: Power-limited fire-alarm riser cable.
26. IGS: Integrated gas spacer cable.



27. ITC: Instrumentation tray cable.
28. ITC-ER: Instrumentation tray cable, exposed run.
29. MC: Metal-clad cable.
30. MC-HL: Metal-clad cable, hazardous location.
31. MI: Mineral-insulated, metal-sheathed cable.
32. MTW: (machine tool wiring) Moisture-, heat-, and oil-resistant thermoplastic cable.
33. MV: Medium-voltage cable.
34. NM: Nonmetallic sheathed cable.
35. NMC: Nonmetallic sheathed cable with corrosion-resistant nonmetallic jacket.
36. NMS: Nonmetallic sheathed cable with signaling, data, and communications conductors, plus power or control conductors.
37. NPLF: Non-power-limited fire-alarm circuit cable.
38. NPLFP: Non-power-limited fire-alarm circuit cable for environmental air spaces.
39. NPLFR: Non-power-limited fire-alarm circuit riser cable.
40. NUCC: Nonmetallic underground conduit with conductors.
41. OFC: Conductive optical fiber general-purpose cable.
42. OFCG: Conductive optical fiber general-purpose cable.
43. OFCP: Conductive optical fiber plenum cable.
44. OFCR: Conductive optical fiber riser cable.
45. OFN: Nonconductive optical fiber general-purpose cable.
46. OFNG: Nonconductive optical fiber general-purpose cable.
47. OFNP: Nonconductive optical fiber plenum cable.
48. OFNR: Nonconductive optical fiber riser cable.
49. P: Marine shipboard cable.
50. PLTC: Power-limited tray cable.
51. PLTC-ER: Power-limited tray cable, exposed run.
52. PV: Photovoltaic cable.
53. RHH: (high heat) Thermoset rubber, heat-resistant cable.
54. RHW: Thermoset rubber, moisture-resistant cable.
55. SA: Silicone rubber cable.
56. SE: Service-entrance cable.
57. SER: Service-entrance cable, round.
58. SEU: Service-entrance cable, flat.
59. SIS: Thermoset cable for switchboard and switchgear wiring.
60. TBS: Thermoplastic cable with outer braid.
61. TC: Tray cable.
62. TC-ER: Tray cable, exposed run.
63. TC-ER-HL: Tray cable, exposed run, hazardous location.
64. THW: Thermoplastic, heat- and moisture-resistant cable.
65. THHN: Thermoplastic, heat-resistant cable with nylon jacket outer sheath.
66. THHW: Thermoplastic, heat- and moisture-resistant cable.
67. THWN: Thermoplastic, moisture- and heat-resistant cable with nylon jacket outer sheath.
68. TW: Thermoplastic, moisture-resistant cable.
69. UF: Underground feeder and branch-circuit cable.
70. USE: Underground service-entrance cable.
71. XHH: Cross-linked polyethylene, heat-resistant cable.
72. XHHW: Cross-linked polyethylene, heat- and moisture-resistant cable.

D. Abbreviations and Acronyms for Electrical Flexible Cord Types:

1. SEO: 600 V extra-hard-usage, hard-service cord with thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer covering for damp locations.
2. SEOW: 600 V extra-hard-usage, hard-service cord with thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer covering for damp or wet locations.
3. SEOO: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer covering for damp locations.
4. SEOOW: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer covering for damp or wet locations.
5. SJEO: 300 V hard-usage, junior hard-service cord with thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer cover for damp locations.
6. SJEOW: 300 V hard-usage, junior hard-service cord with thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer cover for damp or wet locations.
7. SJEOO: 300 V hard-usage, junior hard-service cord with oil-resistant thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer cover for damp locations.
8. SJEOOW: 300 V hard-usage, junior hard-service cord with oil-resistant thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer cover for damp or wet locations.
9. SJO: 300 V hard-usage, junior hard-service cord with thermoset insulation and oil-resistant thermoset outer cover for damp locations.
10. SJOW: 300 V hard-usage, junior hard-service cord with thermoset insulation and oil-resistant thermoset outer cover for damp or wet locations.
11. SJOO: 300 V hard-usage, junior hard-service cord with oil-resistant thermoset insulation and oil-resistant thermoset outer cover for damp locations.
12. SJOOW: 300 V hard-usage, junior hard-service cord with oil-resistant thermoset insulation and oil-resistant thermoset outer cover for damp or wet locations.
13. SJTO: 300 V hard-usage, junior hard-service cord with thermoplastic insulation and oil-resistant thermoplastic outer cover for damp locations.
14. SJTOW: 300 V hard-usage, junior hard-service cord with thermoplastic insulation and oil-resistant thermoplastic outer cover for damp or wet locations.
15. SJTOO: 300 V hard-usage, junior hard-service cord with oil-resistant thermoplastic insulation and oil-resistant thermoplastic outer cover for damp locations.
16. SJTOOW: 300 V hard-usage, junior hard-service cord with oil-resistant thermoplastic insulation and oil-resistant thermoplastic outer cover for damp or wet locations.
17. SO: 600 V extra-hard-usage, hard-service cord with thermoset insulation and oil-resistant thermoset outer covering for damp locations.
18. SOW: 600 V extra-hard-usage, hard-service cord with thermoset insulation and oil-resistant thermoset outer covering for damp or wet locations.
19. SOO: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoset insulation and oil-resistant thermoset outer covering for damp locations.
20. SOOW: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoset insulation and oil-resistant thermoset outer covering for damp or wet locations.
21. STO: 600 V extra-hard-usage, hard-service cord with thermoplastic insulation and oil-resistant thermoplastic outer covering for damp locations.
22. STOW: 600 V extra-hard-usage, hard-service cord with thermoplastic insulation and oil-resistant thermoplastic outer covering for damp or wet locations.
23. STOO: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoplastic insulation and oil-resistant thermoplastic outer covering for damp locations.

24. STOOW: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoplastic insulation and oil-resistant thermoplastic outer covering for damp or wet locations.

E. Definitions:

1. 8-Position 8-Contact (8P8C) Modular Jack: An unkeyed jack with up to eight contacts commonly used to terminate twisted-pair and multiconductor Ethernet cable. Also called a "TIA-1096 miniature 8-position series jack" (8PSJ), or an "IEC 8877 8-pole jack."
  - a. Be careful when suppliers use "RJ45" generically. Obsolete RJ45 jacks used for analog telephone cables have rejection keys. 8P8C jacks used for digital telephone cables and Ethernet cables do not have rejection keys.
2. Basic Impulse Insulation Level (BIL): Reference insulation level expressed in impulse crest voltage with a standard wave not longer than 1.5 times 50 microseconds and 1.5 times 40 microseconds.
3. Cable: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "cable" is (1) a conductor with insulation, or a stranded conductor with or without insulation (single-conductor cable); or (2) a combination of conductors insulated from one another (multiple-conductor cable).
4. Communications Jack: A fixed connecting device designed for insertion of a communications cable plug.
5. Communications Outlet: One or more communications jacks, or cables and plugs, mounted in a box or ring, with a suitable protective cover.
6. Conductor: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "conductor" is (1) a wire or combination of wires not insulated from one another, suitable for carrying an electric current; (2) (National Electrical Safety Code) a material, usually in the form of wire, cable, or bar, suitable for carrying an electric current; or (3) (general) a substance or body that allows a current of electricity to pass continuously along it.
7. Designated Seismic System: A system component that requires design in accordance with Ch. 13 of ASCE/SEI 7 and for which the Component Importance Factor is greater than 1.0.
8. Direct Buried: Installed underground without encasement in concrete or other protective material.
9. Enclosure: The case or housing of an apparatus, or the fence or wall(s) surrounding an installation, to prevent personnel from accidentally contacting energized parts or to protect the equipment from physical damage. Types of enclosures and enclosure covers include the following:
  - a. Cabinet: An enclosure that is designed for either surface mounting or flush mounting and is provided with a frame, mat, or trim in which a swinging door or doors are or can be hung.
  - b. Concrete Box: A box intended for use in poured concrete.
  - c. Conduit Body: A means for providing access to the interior of a conduit or tubing system through one or more removable covers at a junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.
  - d. Conduit Box: A box having threaded openings or knockouts for conduit, EMT, or fittings.

- e. Cutout Box: An enclosure designed for surface mounting that has swinging doors or covers secured directly to and telescoping with the walls of the enclosure.
  - f. Device Box: A box with provisions for mounting a wiring device directly to the box.
  - g. Extension Ring: A ring intended to extend the sides of an outlet box or device box to increase the box depth, volume, or both.
  - h. Floor Box: A box mounted in the floor intended for use with a floor box cover and other components to complete the floor box enclosure.
  - i. Floor-Mounted Enclosure: A floor box and floor box cover assembly with means to mount in the floor that is sealed against the entrance of scrub water at the floor level.
  - j. Floor Nozzle: An enclosure used on a wiring system, intended primarily as a housing for a receptacle, provided with a means, such as a collar, for surface-mounting on a floor, which may or may not include a stem to support it above the floor level, and is sealed against the entrance of scrub water at the floor level.
  - k. Junction Box: A box with a blank cover that joins different runs of raceway or cable and provides space for connection and branching of the enclosed conductors.
  - l. Outlet Box: A box that provides access to a wiring system having pryout openings, knockouts, threaded entries, or hubs in either the sides or the back, or both, for the entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting an outlet box cover, but without provisions for mounting a wiring device directly to the box.
  - m. Pedestal Floor Box Cover: A floor box cover that, when installed as intended, provides a means for typically vertical or near-vertical mounting of receptacle outlets above the floor's finished surface.
  - n. Pull Box: A box with a blank cover that joins different runs of raceway and provides access for pulling or replacing the enclosed cables or conductors.
  - o. Raised-Floor Box: A floor box intended for use in raised floors.
  - p. Recessed Access Floor Box: A floor box with provisions for mounting wiring devices below the floor surface.
  - q. Recessed Access Floor Box Cover: A floor box cover with provisions for passage of cords to recessed wiring devices mounted within a recessed floor box.
  - r. Ring: A sleeve, which is not necessarily round, used for positioning a recessed wiring device flush with the plaster, concrete, drywall, or other wall surface.
  - s. Ring Cover: A box cover, with raised center portion to accommodate a specific wall or ceiling thickness, for mounting wiring devices or luminaires flush with the surface.
  - t. Termination Box: An enclosure designed for installation of termination base assemblies consisting of bus bars, terminal strips, or terminal blocks with provision for wire connectors to accommodate incoming or outgoing conductors, or both.
10. Emergency Systems: Those systems legally required and classed as emergency by municipal, state, federal, or other codes, or by any governmental agency having jurisdiction that are designed to ensure continuity of lighting, electrical power, or both, to designated areas and equipment in the event of failure of the normal supply for safety to human life.
11. Essential Electrical Systems: (healthcare facilities) Those systems designed to ensure continuity of electrical power to designated areas and functions of a healthcare facility during disruption of normal power sources, and also to minimize disruption within the internal wiring system.

12. **Fault Limited:** Providing or being served by a source of electrical power that is limited to not more than 100 W when tested in accordance with UL 62368-1.
  - a. The term "fault limited" is intended to encompass most Class 1, 2, and 3 power-limited sources complying with Article 725 of NFPA 70; Class ES1 and ES2 electrical energy sources that are Class PS1 electrical power sources (e.g., USB); and Class ES3 electrical energy sources that are Class PS1 and PS2 electrical power sources (e.g., PoE). See UL 62368-1 for discussion of classes of electrical energy sources and classes of electrical power sources.
13. **High-Performance Building:** A building that integrates and optimizes on a life-cycle basis all major high-performance attributes, including energy conservation, environment, safety, security, durability, accessibility, cost-benefit, productivity, sustainability, functionality, and operational considerations.
14. **Jacket:** A continuous nonmetallic outer covering for conductors or cables.
15. **Luminaire:** A complete lighting unit consisting of a light source such as a lamp, together with the parts designed to position the light source and connect it to the power supply. It may also include parts to protect the light source or the ballast or to distribute the light.
16. **Mode:** The terms "Active Mode," "Off Mode," and "Standby Mode" are used as defined in the Energy Independence and Security Act (EISA) of 2007.
17. **Multi-Outlet Assembly:** A type of surface, flush, or freestanding raceway designed to hold conductors, receptacles, and switches, assembled in the field or at the factory.
18. **Plenum:** A compartment or chamber to which one or more air ducts are connected and that forms part of the air distribution system.
19. **Receptacle:** A fixed connecting device arranged for insertion of a power cord plug. Also called a power jack.
20. **Receptacle Outlet:** One or more receptacles mounted in a box with a suitable protective cover.
21. **Sheath:** A continuous metallic covering for conductors or cables.
22. **UL Category Control Number (CCN):** An alphabetic or alphanumeric code used to identify product categories covered by UL's Listing, Classification, and Recognition Services.
23. **Voltage Class:** For specified circuits and equipment, voltage classes are defined as follows:
  - a. **Control Voltage:** Having electromotive force between any two conductors, or between a single conductor and ground, that is supplied from a battery or other Class 2 or Class 3 power-limited source.
  - b. **Line Voltage:** (1) (controls) Designed to operate using the supplied low-voltage power without transformation. (2) (transmission lines, transformers, SPDs) The line-to-line voltage of the supplying power system.
  - c. **Extra-Low Voltage (ELV):** Not having electromotive force between any two conductors, or between a single conductor and ground, exceeding 30 V(ac rms), 42 V(ac peak), or 60 V(dc).
  - d. **Low Voltage (LV):** Having electromotive force between any two conductors, or between a single conductor and ground, that is rated above 30 V but not exceeding 1000 V.
  - e. **Medium Voltage (MV):** Having electromotive force between any two conductors, or between a single conductor and ground, that is rated about 1 kV but not exceeding 69 kV.

- f. High Voltage: (1) (circuits) Having electromotive force between any two conductors, or between a single conductor and ground, that is rated above 69 kV but not exceeding 230 kV. (2) (safety) Having sufficient electromotive force to inflict bodily harm or injury.
24. Wire: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "wire" is a slender rod or filament of drawn metal. A group of small wires used as a single wire is properly called a "stranded wire." A wire or stranded wire covered with insulation is properly called an "insulated wire" or a "single-conductor cable." Nevertheless, when the context indicates that the wire is insulated, the term "wire" will be understood to include the insulation.

### 1.3 COORDINATION

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions:
  - 1. Notify **Owner** no fewer than (7) **seven** days in advance of proposed interruption of electrical service.
  - 2. Do not proceed with interruption of electrical service without **Owner's** written permission.
  - 3. Coordinate interruption with systems impacted by outage including, but not limited to, the following:
    - a. Exercising generators.
    - b. Emergency lighting.
    - c. Elevators.
    - d. Fire-alarm systems.

### 1.4 PREINSTALLATION MEETINGS

- A. Electrical Preconstruction Conference: Schedule conference with Engineer and Owner, not later than **10** days after notice to proceed. Agenda topics include, but are not limited to, the following:
  - 1. Electrical installation schedule.
  - 2. Value analysis proposals and requests for substitution of electrical equipment.
  - 3. Utility work coordination and class of service requests.

### 1.5 ACTION SUBMITTALS

- A. Coordination Drawings for Structural Supports: Show coordination of structural supports for equipment and devices, including restraints and bracing for control of seismic and wind loads, with other systems, equipment, and structural supports in the vicinity.
- B. Coordination Drawings for Ceiling Areas: Where indicated on drawings, provide reflected ceiling plan(s), supplemented by sections and other details, drawn to scale, in accordance with

Section 013100 "Project Management and Coordination," on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Suspended ceiling components.
2. Structural members to which equipment and suspension systems will be attached.
3. Size and location of access panels on ceilings.
4. Elevation, size, and route of sprinkler piping.
5. Elevation, size, and route of plumbing piping.
6. Elevation, size, and route of ductwork.
7. Elevation, size, and route of cable tray.
8. Elevation, size, and route of conduit.
9. Elevation and size of wall-mounted and ceiling-mounted equipment.
10. Access panels.
11. Sprinklers.
12. Air inlets and outlets.
13. Control modules.
14. Luminaires.
15. Communications devices.
16. Speakers.
17. Security devices.
18. Fire-alarm devices.
19. Indicate clear dimensions for maintenance access in front of equipment.
20. Indicate dimensions of fully-open access doors.

C. Coordination Drawings for Conduit Routing: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

D. Coordination Drawings for Bus Assembly Routing: Floor plans and sections, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Scaled bus-assembly layouts and relationships between components and adjacent structural, mechanical, and electrical elements.
2. Vertical and horizontal enclosed bus-assembly runs, offsets, and transitions.
3. Clearances for access above and to the side of enclosed bus assemblies.
4. Vertical elevation of enclosed bus assemblies above the floor or bottom of structure.
5. Support locations, type of support, and weight on each support.
6. Location of adjacent construction elements including luminaires, HVAC and plumbing equipment, fire sprinklers and piping, signal and control devices, and other equipment.

E. Coordination Drawings for Large Equipment Indoor Installations:

1. Location plan, drawn to scale, showing heavy equipment or truck access paths to loading dock or other freight access into building. Indicate available width and height of doors or openings.

2. Floor plan for entry floor and floor where equipment is located, drawn to scale, showing heavy equipment access paths for maintenance and replacement, with the following items shown and coordinated with each other, based on input from installers of the items involved:
  - a. Dimensioned concrete bases, outlines of equipment, conduit entries, and grounding equipment locations.
  - b. If freight elevator must be used, indicate width and height of door and depth of car. Indicate if large equipment must be tipped to use elevator.
  - c. Dimensioned working clearances and dedicated areas below and around electrical equipment where obstructions and tripping hazards are prohibited.
  
3. Reflected ceiling plans for entry floor and floor where equipment is located, drawn to scale, on which the following items shown and coordinated with each other, based on input from installers of the items involved:
  - a. Support locations, type of support, and weight on each support. Locate structural supports for structure-supported raceways.
  - b. Location of lighting fixtures, sprinkler piping and sprinklers, ducts and diffusers, and other obstructions, indicating available overhead clearance.
  - c. Dimensioned working clearances and dedicated areas above and around electrical equipment where foreign systems and equipment are prohibited.

F. Coordination Drawings for Large Equipment Outdoor Installations:

1. Utilities site plan, drawn to scale, showing heavy equipment or truck access paths for maintenance and replacement, with the following items shown and coordinated with each other, based on input from installers of the items involved:
  - a. Fences and walls, dimensioned concrete bases, outlines of equipment, conduit entries, and grounding and bonding locations.
  - b. Indicate clear dimensions for fence gates and wall openings.
  - c. Indicate depth and type of ground cover, and locations of trees, shrubbery, and other obstructions in access path.
  - d. Indicate clear height below tree branches, overhead lines, bridges, and other overhead obstructions in access path, or where cranes and hoists will be needed to handle large electrical equipment.
  - e. Support locations, type of support, and weight on each support. Locate structural supports for structure-supported raceways.
  - f. Dimensioned working clearances and dedicated areas around electrical equipment.

## 1.6 QUALIFICATIONS

- A. Qualified Regional Manufacturer: Manufacturer that maintains a service center capable of providing training, parts, and emergency on-site repairs to Project site with response time less than **forty-eight hours**.
- B. Structural Professional Engineer: Professional engineer possessing active qualifications with expertise in structural engineering, **including seismic- and wind-load modeling and analysis**.



- C. Electrical Professional Engineer: Professional engineer possessing active qualifications with expertise in electrical engineering, including electrical power system modeling and analysis of electrical safety in accordance with NFPA 70E.
- D. Lighting Professional Engineer: Professional engineer possessing active qualifications in the following:
  - 1. Expertise in electrical engineering, lighting design, and structural requirements for exterior poles and standards.
  - 2. Lighting Certified (LC) Professional by the National Council on Qualifications for the Lighting Professions (NCQLP).
- E. EPM Specialist: Recognized experts possessing the following qualifications in accordance with NFPA 70B:
  - 1. Technical Competence: Person should, by education, training, and experience, be well-rounded in all aspects of electrical maintenance.
  - 2. Administrative and Supervisory Skills: Person should be skilled in planning and development of long-range objectives to achieve specific results and should be able to command respect and solicit cooperation of persons involved in EPM Program development.
- F. ERMC-S-PVC Installers: Installer possessing active qualifications and able to present unexpired certified Installer credentials issued by ERMC-S-PVC manufacturer prior to starting installation.
- G. Medium-Voltage Cable Installer: Entity possessing active qualifications with training and manufacturer certification to install, splice, and terminate medium-voltage cable **in accordance with electrical utility service provider's requirements.**
- H. Medium-Voltage Equipment Installer: Entity possessing active qualifications with documented training and experience with hazards and safety requirements associated with installation and operation of medium-voltage equipment **in accordance with electrical utility service provider requirements.**
- I. Electrical Power Monitoring Installers: Installer possessing active qualifications and able to present unexpired certified Installer credentials issued by manufacturer prior to starting installation.
- J. EVSE Installers: Installer possessing active qualifications and able to present unexpired certified Installer credentials issued by EVSE manufacturer prior to starting installation.
- K. Generator Set Installers: Installer possessing active qualifications and able to present unexpired certified Installer credentials issued by generator set manufacturer prior to starting installation.
- L. Lightning Protection System Installers: Installer possessing active qualifications and able to present **unexpired UL-Listed Installer, UL Category Control Number OWAY, credentials or unexpired LPI Master Installer credentials** prior to starting installation.
- M. Power Quality Specialist: Recognized experts possessing active credentials from a qualified electrical testing laboratory recognized by authorities having jurisdiction, and able to present

unexpired NICET Level 4 credentials with documented experience in power quality testing for installations similar in complexity to this Project.

- N. Low-Voltage Electrical Testing and Inspecting Agency: Entities possessing active credentials from a qualified electrical testing laboratory recognized by authorities having jurisdiction.
  - 1. On-site electrical testing supervisors must have documented certification and experience with testing electrical equipment in accordance with NETA testing standards.
- O. Power-Limited Electrical Testing Agency: Entity possessing active credentials from a qualified electrical testing laboratory recognized by authorities having jurisdiction.
  - 1. On-site power-limited testing supervisor must have BICSI Registered Communications Distribution Designer certification and documented training and experience with testing power-limited equipment in accordance with NETA testing standards.
- P. Outdoor Pole Testing and Inspecting Agency: Entity possessing active qualifications with documented training and experience in accordance with ASTM C1093 for foundation testing and inspections.

#### 1.7 FIELD CONDITIONS

- A. Modeling, analysis, product selection, installation, and quality control for Work specified in Division 26 must comply with requirements specified in Section 260011 "Facility Performance Requirements for Electrical."
- B. Service Conditions for Electrical Power Equipment: Besides conditions specified in Section 260011 "Facility Performance Requirements for Electrical," specified electrical power equipment must be suitable for operation under service conditions specified as usual service conditions in applicable NEMA PB series, IEEE C37 series, and IEEE C57 series standards.

#### 1.8 SUBSTITUTION LIMITATIONS FOR ELECTRICAL EQUIPMENT

- A. Substitution requests for electrical equipment will be entertained under the following conditions:
  - 1. Substitution requests may be submitted for consideration prior to the Electrical Preconstruction Conference if accompanied by value analysis data indicating that substitution will comply with Project performance requirements while significantly increasing value for Owner throughout life of facility.
  - 2. Substitution requests may be submitted for consideration concurrently with submission of power system study reports when those reports indicate that substitution is necessary for safety of maintenance personnel and facility occupants.
  - 3. Contractor is responsible for sequencing and scheduling power system studies and electrical equipment procurement. After the Electrical Preconstruction Conference, insufficient lead time for electrical equipment delivery will not be considered a valid reason for substitution.

## 1.9 FACILITY ELECTRICAL PREVENTIVE MAINTENANCE (EPM) PROGRAM BINDERS

- A. Description: Set of binders containing operation and maintenance data for facility's electrical equipment that was compiled during analysis of installed electrical Work for Facility EPM Program development.
- B. Applicable Standards:
  - 1. Regulatory Requirements: Comply with recommendations in NFPA 70B.
  - 2. General Characteristics:

## PART 2 - EXECUTION

### 2.1 INSTALLATION OF ELECTRICAL WORK

- A. Unless more stringent requirements are specified in the Contract Documents or manufacturers' written instructions, comply with NFPA 70 and NECA NEIS 1 for installation of Work specified in Division 26. Consult Architect for resolution of conflicting requirements.

### 2.2 FIELD QUALITY CONTROL

- A. Administrant for Low-Voltage Electrical Tests and Inspections:
  - 1. **Owner** will engage qualified low-voltage electrical testing and inspecting agency to administer and perform tests and inspections.
  - 2. Engage qualified low-voltage electrical testing and inspecting agency to administer and perform tests and inspections.
  - 3. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.
  - 4. Administer and perform tests and inspections.

END OF SECTION 260010

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Field conditions and other facility performance requirements applicable to Work specified in Division 26.

1.2 FIELD CONDITIONS

A. Seismic Hazard Design Loads:

1. Unless otherwise indicated on Contract Documents, specified Work must withstand seismic hazard design loads determined in accordance with requirements specified in this Section, adjusted for installed elevation above or below grade.
  - a. The term "withstand" means "unit must remain in place without separation of parts from unit when subjected to specified seismic hazard design loads and unit must be fully operational after seismic event."
  - b. Data indicated below to be determined by Delegated Design Contractor must be obtained by Contractor and must be included in individual component submittal packages.
  - c. Coordinate seismic design calculations with wind-load calculations for equipment mounted outdoors.
  - d. Building Occupancy Category: IV.
  - e. Seismic Design Category: D
  - f. Site Classification: D.
  - g. Sds: .745

B. Wind Hazard Design Loads:

1. Coordinate design wind-load calculations with seismic-load calculations for equipment requiring both seismic- and wind-load reinforcement. Comply with requirements in other Sections in addition to those in this Section.

C. Altitude:

1. Sea level to 1000 ft.

END OF SECTION 260011

## SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Copper building wire.
2. Metal-clad cable, Type MC.
3. Fire-alarm wire and cable.
4. Connectors and splices.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

#### 1.3 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cerro Wire LLC.
2. Southwire Company, LLC.
3. Unified Wire & Cable.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

E. Conductor Insulation:

1. Type THHN and Type THWN-2: Comply with UL 83.

#### 1.4 METAL-CLAD CABLE, TYPE MC

- A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Atkore Inc.
  - 2. Encore Wire Corporation.
  - 3. Southwire Company, LLC.
- C. Standards:
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
  - 2. Comply with UL 1569.
  - 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Circuits:
  - 1. Single circuit.
- E. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.
- F. Ground Conductor: Insulated.
- G. Conductor Insulation:
  - 1. Type TFN/THHN/THWN-2: Comply with UL 83.

#### 1.5 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. 3M Electrical Products.
  - 2. ABB, Electrification Business.
  - 3. Hubbell Utility Solutions; Hubbell Incorporated.
  - 4. ILSCO.
- C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc diecast with set screws, designed to connect conductors specified in this Section.

D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.

1. Material: Copper.
2. Type: One hole with standard barrels.
3. Termination: Compression.

## PART 2 - EXECUTION

### 2.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders:

1. Copper; stranded for all wire sizes.
2. Copper for feeders smaller than No. 1/0 AWG; copper or aluminum for feeders No. 1/0 AWG and larger. Conductors must be stranded.

B. Branch Circuits:

1. Copper. Stranded for all wire sizes.
2. Copper for feeders smaller than No. 1/0 AWG; copper or aluminum for feeders No. 1/0 AWG and larger. Conductors must be stranded.

### 2.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN/THWN-2, single conductors in raceway

B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN/THWN-2, single conductors in raceway

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway

E. Exposed Branch Circuits, Including in Crawlspace: Type THHN/THWN-2, single conductors in raceway

F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway

### 2.3 INSTALLATION, GENERAL

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

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

## 2.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material, and that possess equivalent or better mechanical strength and insulation ratings than un-spliced conductors.
  - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

## 2.5 IDENTIFICATION

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

## 2.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

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

## 2.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.



END OF SECTION 260519

## SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Grounding and bonding conductors.
2. Grounding and bonding clamps.
3. Grounding and bonding bushings.
4. Grounding electrodes.

##### B. Product Data:

1. For each type of product indicated.

### PART 2 - PRODUCTS

#### 2.1 GROUNDING AND BONDING CONDUCTORS

##### A. Equipment Grounding Conductor:

1. General Characteristics: 600 V, THHN/THWN-2, copper wire or cable, green color, in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

##### B. Isolated Equipment Grounding Conductor:

1. General Characteristics: 600 V, THHN/THWN-2, copper wire or cable, green color with one or more yellow stripes, in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

##### C. ASTM - Bare Copper Grounding and Bonding Conductor:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Anderson; brand of Hubbell.
  - b. ERICO; brand of nVent Electrical plc.
  - c. Harger Lightning & Grounding; business of Harger Inc.
2. Referenced Standards: Complying with one or more of the following:
  - a. Soft or Annealed Copper Wire: ASTM B3
  - b. Concentric-Lay Stranded Copper Conductor: ASTM B8.
  - c. Tin-Coated Soft or Annealed Copper Wire: ASTM B33.

- d. 19-Wire Combination Unilay-Stranded Copper Conductor: ASTM B787/B787M.

## 2.2 GROUNDING AND BONDING CLAMPS

- A. Description: Clamps suitable for attachment of grounding and bonding conductors to grounding electrodes, pipes, tubing, and rebar.
- B. Source Limitations: Obtain products from single manufacturer.
- C. Performance Criteria:
  - 1. Regulatory Requirements:
    - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
  - 2. Listing Criteria:
    - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
- D. UL KDER and KDSH - Hex-Fitting-Type Pipe and Rod Grounding and Bonding Clamp:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Cooper B-Line; brand of Eaton, Electrical Sector
    - b. Crouse-Hinds; brand of Eaton, Electrical Sector
    - c. ERICO; brand of nVent Electrical plc
    - d. Harger Lightning & Grounding; business of Harger Inc.
    - e. ILSCO
    - f. O-Z/Gednev; brand of Emerson Electric Co., Automation Solutions, Appleton Group
  - 2. General Characteristics:
    - a. Two pieces with **zinc-plated** bolts.
    - b. Clamp Material: **Silicon bronze**.
    - c. Listed for outdoor use.
- E. UL KDER - Exothermically Welded Connection <**Insert drawing designation**>:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Burndy; brand of Hubbell Electrical Solutions, Hubbell Incorporated
    - b. Crouse-Hinds; brand of Eaton, Electrical Sector
    - c. ERICO; brand of nVent Electrical plc
    - d. Harger Lightning & Grounding; business of Harger Inc.

2. General Characteristics: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

## 2.3 GROUNDING AND BONDING BUSHINGS

- A. Description: Bonding bushings connect conduit fittings, tubing fittings, threaded metal conduit, and unthreaded metal conduit to metal boxes and equipment enclosures, and have one or more bonding screws intended to provide electrical continuity between bushing and enclosure. Grounding bushings have provision for connection of bonding or grounding conductor and may or may not also have bonding screws.
- B. Source Limitations: Obtain products from single manufacturer.
- C. Performance Criteria:
  1. Regulatory Requirements:
    - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
  2. Listing Criteria:
    - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
- D. UL KDER - Bonding Bushing:
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Crouse-Hinds; brand of Eaton, Electrical Sector
    - b. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated
    - c. O-Z/Gednev; brand of Emerson Electric Co., Automation Solutions, Appleton Group
  2. General Characteristics: Threaded bushing with insulated throat.
- E. UL KDER - Grounding Bushing:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Crouse-Hinds; brand of Eaton, Electrical Sector.
    - b. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    - c. O-Z/Gednev; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
  2. General Characteristics: Threaded bushing with insulated throat and mechanical-type wire terminal.

## 2.4 GROUNDING ELECTRODES

- A. Description: Grounding electrodes include rod electrodes, ring electrodes, metal underground water pipes, metal building frames, concrete-encased electrodes, and pipe and plate electrodes.
- B. Source Limitations: Obtain products from single manufacturer.
- C. Performance Criteria:
  - 1. Regulatory Requirements:
    - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
  - 2. Listing Criteria:
    - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
- D. UL KDER - Rod Electrode:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Continental Industries; brand of Hubbell Utility Solutions; Hubbell Incorporated.
    - b. ERICO; brand of nVent Electrical plc.
    - c. Harger Lightning & Grounding; business of Harger, Inc.
  - 2. General Characteristics: **Copper-clad steel; 3/4 inch by 10 ft.**

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine facility's grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of electrical system.
- B. Inspect test results of grounding system measured at point of electrical service equipment connection.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with connection of electrical service equipment only after unsatisfactory conditions have been corrected.

### 3.2 SELECTION OF GROUNDING AND BONDING CONDUCTORS

- A. Conductors: Install solid conductor for **8 AWG** and smaller, and stranded conductors for **6 AWG** and larger unless otherwise indicated.
- B. Custom-Length Insulated Equipment Bonding Jumpers: 6 AWG, 19-strand, Type THHN.
- C. Bonding Conductor: 4 AWG or 6 AWG, stranded conductor.

### 3.3 SELECTION OF CONNECTORS

- A. Conductor Terminations and Connections:
  - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  - 2. Connections to Structural Steel: Welded connectors.

### 3.4 INSTALLATION

- A. Comply with manufacturer's published instructions.
- B. Reference Standards:
  - 1. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
  - 2. Consult Architect for resolution of conflicting requirements.
- C. Special Techniques:
  - 1. Conductors:
    - a. Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
  - 2. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
    - a. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
    - b. Make connections with clean, bare metal at points of contact.
    - c. Make aluminum-to-steel connections with stainless steel separators and mechanical clamps.
    - d. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
    - e. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

- f. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
    - 1) Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate adjacent parts.
    - 2) Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
    - 3) Use exothermic-welded connectors for outdoor locations; if disconnect-type connection is required, use bolted clamp.
  - g. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.
3. Electrodes:
- a. Ground Rods: Drive rods until tops are 2 inch below finished floor or final grade unless otherwise indicated.
    - 1) Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
    - 2) Use exothermic welds for below-grade connections.
4. Grounding at Service:
- a. Equipment grounding conductors and grounding electrode conductors must be connected to ground bus. Install main bonding jumper between neutral and ground buses.
5. Equipment Grounding:
- a. Install insulated equipment grounding conductors with feeders and branch circuits.
  - b. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
    - 1) Feeders and branch circuits.
    - 2) Single-phase motor and appliance branch circuits.
    - 3) Three-phase motor and appliance branch circuits.
  - c. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
  - d. Isolated Grounding Receptacle Circuits: Install insulated equipment grounding conductor connected to receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment

grounding conductor terminal of applicable derived system or service unless otherwise indicated.

- e. Isolated Equipment Enclosure Circuits: For designated equipment supplied by branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of applicable derived system or service unless otherwise indicated.

### 3.5 PROTECTION

- A. After installation, protect grounding and bonding cables and equipment from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 260526



## SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Support, anchorage, and attachment components.
2. Fabricated metal equipment support assemblies.

##### B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

#### 1.2 ACTION SUBMITTALS

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

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
  - a. Slotted support systems, hardware, and accessories.
  - b. Clamps.
  - c. Hangers.
  - d. Fasteners.
  - e. Anchors.
2. Include rated capacities and furnished specialties and accessories.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

##### A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame Rating: Class 1.
2. Self-extinguishing according to ASTM D635.

## 2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32 inch diameter holes at a maximum of 8 inch on center in at least one surface.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CADDY; brand of nVent Electrical plc.
    - b. Cooper B-line; brand of Eaton, Electrical Sector.
    - c. Unistrut; Atkore International.
  2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
  3. Material for Channel, Fittings, and Accessories: Galvanized steel.
  4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
- B. Conduit and Cable Support Devices: **Steel** hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs must have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body must be made of malleable iron.
- D. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.
- E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Mechanical-Expansion Anchors: Insert-wedge-type, **zinc-coated** steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Cooper B-line; brand of Eaton, Electrical Sector.
      - 2) Empire Industries, Inc.
      - 3) Hilti, Inc.
  2. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
  3. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
  4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A325.
  5. Toggle Bolts: **All** steel springhead type.
  6. Hanger Rods: Threaded steel.

## PART 3 - EXECUTION

### 3.1 SELECTION

- A. Comply with the following standards for selection and installation of hangers and supports, except where requirements on Drawings or in this Section are stricter:
  - 1. NECA NEIS 101
  - 2. NECA NEIS 102.
  - 3. NECA NEIS 105.
  - 4. NECA NEIS 111.
- B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- C. Comply with requirements for raceways and boxes specified in Section 260533 "Raceway and Boxes for Electrical Systems."
- D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and ERMC as **required by** NFPA 70, NEC. Minimum rod size must be 1/4 inch in diameter.
- E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted system, sized so capacity can be increased by at least **25** percent in future without exceeding specified design load limits.
  - 1. Secure raceways and cables to these supports with two-bolt conduit clamps, single-bolt conduit clamps, or single-bolt conduit clamps using spring friction action for retention in support channel.
- F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2 inch and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

### 3.2 INSTALLATION OF SUPPORTS

- A. Comply with NECA NEIS 101 for installation requirements except as specified in this article.
- B. Raceway Support Methods: In addition to methods described in NECA NEIS 1, EMT may be supported by openings through structure members, in accordance with NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination must be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
  2. To New Concrete: Bolt to concrete inserts.
  3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
  4. To Existing Concrete: Expansion anchor fasteners.
  5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inch thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inch thick.
  6. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
  7. To Light Steel: Sheet metal screws.
  8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate **by means that comply with seismic-restraint strength and anchorage requirements.**
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

### 3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M. Submit welding certificates.

END OF SECTION 260529

## SECTION 260533.13 - CONDUITS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Type EMT-SS duct raceways and elbows.
2. Type EMT-S duct raceways and elbows.
3. Type ENT duct raceways and fittings.
4. Type HDPE duct raceways and fittings.
5. Type ERMC-SS duct raceways, elbows, couplings, and nipples.
6. Type ERMC-S duct raceways, elbows, couplings, and nipples.
7. Type FMC-S duct raceways.
8. Type FMT duct raceways.
9. Type LFMC duct raceways.
10. Type LFNC duct raceways.
11. Type PVC duct raceways and fittings.
12. Fittings for conduit, tubing, and cable.
13. Electrically conductive corrosion-resistant compounds for threaded conduit.
14. Solvent cements.

##### B. Products Installed, but Not Furnished, under This Section:

1. See Section 260553 "Identification for Electrical Systems" for electrical equipment labels.

#### 1.2 DEFINITIONS

- A. Conduit: A structure containing one or more duct raceways.
- B. Duct Raceway: A single enclosed raceway for conductors or cable.
- C. Duct Bank: An arrangement of conduit providing one or more continuous duct raceways between two points.

#### 1.3 ACTION SUBMITTALS

##### A. Product Data:

1. Type EMT-SS duct raceways and elbows.
2. Type EMT-S duct raceways and elbows.
3. Type ENT duct raceways and fittings.
4. Type HDPE duct raceways and fittings.
5. Type ERMC-SS duct raceways, elbows, couplings, and nipples.
6. Type ERMC-S duct raceways, elbows, couplings, and nipples.

7. Type FMC-S duct raceways.
8. Type FMT duct raceways.
9. Type LFMC duct raceways.
10. Type LFNC duct raceways.
11. Type PVC duct raceways and fittings.
12. Fittings for conduit, tubing, and cable.
13. Electrically conductive corrosion-resistant compounds for threaded conduit.
14. Solvent cements.

## PART 2 - PRODUCTS

### 2.1 TYPE EMT-SS DUCT RACEWAYS AND ELBOWS

#### A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN FJMX; including UL 797A.

#### B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

#### C. UL FJMX - Stainless Steel Electrical Metal Tubing (EMT-SS) and Elbows:

1. Material: Stainless steel.
2. Options:
  - a. Minimum Trade Size: **Trade size 3/4"**.
  - b. Colors: As indicated on Drawings.

### 2.2 TYPE EMT-S DUCT RACEWAYS AND ELBOWS

#### A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN FJMX; including UL 797.

#### B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

#### C. UL FJMX - Steel Electrical Metal Tubing (EMT-S) and Elbows:

1. Material: Steel.
2. Options:

- a. Exterior Coating: Zinc
- b. Interior Coating: Zinc
- c. Minimum Trade Size: Trade size 3/4".
- d. Colors: As indicated on Drawings.

## 2.3 TYPE ENT DUCT RACEWAYS AND FITTINGS

### A. Performance Criteria:

- 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
- 2. Listing Criteria: UL CCN FKHU; including UL 1653.

### B. Source Quality Control:

- 1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

### C. UL FKHU - Electrical Nonmetallic Tubing (ENT) and Fittings:

- 1. Options:
  - a. Minimum Trade Size: Trade size 3/4".
  - b. Fittings:
    - 1) Mechanically Attached Fittings: UL 1653.
    - 2) Solvent-Attached Fittings: UL 651.

## 2.4 TYPE HDPE AND TYPE EPEC DUCT RACEWAYS AND FITTINGS

### A. Performance Criteria:

- 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
- 2. Listing Criteria: UL CCN EAZX; including UL 651A.

### B. Source Quality Control:

- 1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

### C. UL EAZX - Schedule 40 Electrical HDPE Underground Conduit (HDPE-40):

- 1. Dimensional Specifications: Schedule 40.
- 2. Options:
  - a. Minimum Trade Size: Trade size 3/4".

### D. UL EAZX - Schedule 80 Electrical HDPE Underground Conduit (HDPE-80):

- 1. Dimensional Specifications: Schedule 80.
- 2. Options:

- a. Minimum Trade Size: **Trade size 3/4"**.

## 2.5 TYPE ERM-C-SS DUCT RACEWAYS, ELBOWS, COUPLINGS, AND NIPPLES

### A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN DYWV; including UL 6A.

### B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

### C. UL DYWV - Stainless Steel Electrical Rigid Metal Conduit (ERM-C-SS), Elbows, Couplings, and Nipples:

1. Material: Stainless steel.
2. Options:
  - a. Minimum Trade Size: **Trade size 3/4"**.
  - b. Colors: As indicated on Drawings.

## 2.6 TYPE ERM-C-S DUCT RACEWAYS, ELBOWS, COUPLINGS, AND NIPPLES

### A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN DYIX; including UL 6.

### B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

### C. UL DYIX - Galvanized-Steel Electrical Rigid Metal Conduit (ERM-C-S-G), Elbows, Couplings, and Nipples:

1. Exterior Coating: Zinc.
2. Options:
  - a. Interior Coating: Zinc.
  - b. Minimum Trade Size: Trade size 3/4"
  - c. Colors: As indicated on Drawings.



## 2.7 TYPE FMC-S DUCT RACEWAYS

### A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN DXUZ; including UL 1.

### B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

### C. UL DXUZ - Steel Flexible Metal Conduit (FMC-S):

1. Material: Steel.
2. Options:
  - a. Minimum Trade Size: Trade size 3/4".
  - b. Colors: As indicated on Drawings.

## 2.8 TYPE FMT DUCT RACEWAYS

### A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN ILJW; including UL Subject 1652.

### B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

### C. UL ILJW - Steel Flexible Metallic Tubing (FMT):

1. Options:
  - a. Minimum Trade Size: Trade size 3/4".
  - b. Colors: As indicated on Drawings.

## 2.9 TYPE LFMC DUCT RACEWAYS

### A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN DXHR; including UL 360.

- B. Source Quality Control:
  - 1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
- C. UL DXHR - Steel Liquidtight Flexible Metal Conduit (LFMC-S):
  - 1. Material: Steel.
  - 2. Options:
    - a. Minimum Trade Size: Trade size 3/4".
    - b. Colors: As indicated on Drawings.

## 2.10 TYPE LFNC DUCT RACEWAYS

- A. Performance Criteria:
  - 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
  - 2. Listing Criteria: UL CCN DXOQ; including UL 1660.
- B. Source Quality Control:
  - 1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
- C. UL DXOQ - Layered (Type A) Liquidtight Flexible Nonmetallic Conduit (LFNC-A):
  - 1. Additional Criteria: Type A conduit with smooth seamless inner core and cover bonded together with one or more reinforcement layers between core and cover.
  - 2. Options:
    - a. Minimum Trade Size: Trade size 3/4".
    - b. Colors: As indicated on Drawings.
- D. UL DXOQ - Integral (Type B) Liquidtight Flexible Nonmetallic Conduit (LFNC-B):
  - 1. Additional Criteria: Type B conduit with smooth inner surface with integral reinforcement within conduit wall.
  - 2. Options:
    - a. Minimum Trade Size: Trade size 3/4".
    - b. Colors: As indicated on Drawings.
- E. UL DXOQ - Corrugated (Type C) Liquidtight Flexible Nonmetallic Conduit (LFNC-C):
  - 1. Additional Criteria: Type C conduit with corrugated internal and external surfaces without integral reinforcement within conduit wall.
  - 2. Options:
    - a. Minimum Trade Size: Trade size 3/4".
    - b. Colors: As indicated on Drawings.

## 2.11 TYPE PVC DUCT RACEWAYS AND FITTINGS

### A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN DZYR; including UL 651.

### B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

### C. UL DZYR - Schedule 40 Rigid PVC Conduit (PVC-40) and Fittings:

1. Dimensional Specifications: Schedule 40.
2. Options:
  - a. Minimum Trade Size: Trade size 3/4".

### D. UL DZYR - Schedule 80 Rigid PVC Conduit (PVC-80) and Fittings:

1. Dimensional Specifications: Schedule 80.
2. Options:
  - a. Minimum Trade Size: Trade size 3/4".

## 2.12 FITTINGS FOR CONDUIT, TUBING, AND CABLE

### A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

### B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

### C. UL DWTT - Fittings for Type ERM, Type PVC, Type HDPE Duct Raceways:

1. Listing Criteria: UL CCN DWTT; including UL 514B.
2. Options:
  - a. Material: Steel or Die cast.
  - b. Coupling Method: Compression coupling, Raintight compression coupling with distinctive color gland nut, or Setscrew coupling. Setscrew couplings with only single screw per conduit are unacceptable.
  - c. Expansion and Deflection Fittings: UL 651 with flexible bonding jumper.

- D. UL FKAV - Fittings for Type EMT Duct Raceways:
  - 1. Listing Criteria: UL CCN FKAV; including UL 514B.
  - 2. Options:
    - a. Material: Steel or Die cast.
    - b. Coupling Method: Compression coupling, Raintight compression coupling with distinctive color gland nut, or Setscrew coupling. Setscrew couplings with only single screw per conduit are unacceptable.
    - c. Expansion and Deflection Fittings: UL 651 with flexible bonding jumper.
- E. UL ILNR - Fittings for Type FMC Duct Raceways:
  - 1. Listing Criteria: UL CCN ILNR; including UL 514B.
- F. UL DXAS - Fittings for Type LFMC and Type LFNC Duct Raceways:
  - 1. Listing Criteria: UL CCN DXAS; including UL 514B.

## 2.13 ELECTRICALLY CONDUCTIVE CORROSION-RESISTANT COMPOUNDS FOR THREADED CONDUIT

- A. Performance Criteria:
  - 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
  - 2. Listing Criteria: UL CCN FOIZ; including UL Subject 2419.
- B. Source Quality Control:
  - 1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

## 2.14 SOLVENT CEMENTS

- A. Performance Criteria:
  - 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
  - 2. Listing Criteria: UL CCN DWTT; including UL 514B.
- B. Source Quality Control:
  - 1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

## PART 3 - EXECUTION

### 3.1 SELECTION OF CONDUITS FOR ELECTRICAL SYSTEMS

- A. Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NFPA 70 for selection of duct raceways. Consult Architect for resolution of conflicting requirements.
- B. Special Instructions Regarding HDPE Conduits: Although Article 353 of NFPA 70 permits use of HDPE conduits where encased in concrete aboveground, UL CCN EAZX listing requirements state that HDPE underground conduits are intended only for use where direct buried with or without being encased in concrete. Specified Type HDPE underground conduits are not permitted to be used aboveground on Project.
- C. Outdoors:
  - 1. Exposed and Subject to Severe Physical Damage: ERM C.
  - 2. Exposed and Subject to Physical Damage: ERM C.
    - a. Locations less than 2.5 m (8 ft) above finished floor.
  - 3. Exposed and Not Subject to Physical Damage: ERM C and PVC-80.
  - 4. Concealed Aboveground: ERM C, EMT, PVC-80, PVC-40.
  - 5. Direct Buried: PVC-80, PVC-40, HDPE-80, HDPE-40.
  - 6. Concrete Encased Not in Trench: PVC-80 and PVC-40.
  - 7. Concrete Encased in Trench: PVC-80, PVC-40, HDPE-80, HDPE-40.
  - 8. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC, LFNC-A, LFNC-B.
- D. Indoors:
  - 1. Hazardous Classified Locations: ERM C.
  - 2. Exposed and Subject to Severe Physical Damage: ERM C. Locations include the following:
    - a. Loading docks.
    - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    - c. Mechanical rooms.
    - d. Gymnasiums.
  - 3. Exposed and Subject to Physical Damage: ERM C and EMT. Locations include the following:
    - a. Locations less than 2.5 m (8 ft) above finished floor.
    - b. Stub-ups to above suspended ceilings.
  - 4. Exposed and Not Subject to Physical Damage: ERM C, EMT, PVC-80.
  - 5. Concealed in Ceilings and Interior Walls and Partitions: ERM C, EMT, PVC-80, PVC-40.
  - 6. Damp or Wet Locations: ERM C.

7. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC, FMC, LFNC-A, LFNC-B.
- E. Duct Fittings: Select fittings in accordance with NEMA FB 2.10 guidelines.
1. ERMC: Provide threaded-type fittings unless otherwise indicated.

### 3.2 INSTALLATION OF CONDUITS FOR ELECTRICAL SYSTEMS

- A. Comply with manufacturer's published instructions.
- B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturers' published instructions, comply with the following:
1. Type EMT-SS: Article 358 of NFPA 70 and NECA NEIS 101.
  2. Type EMT-S: Article 358 of NFPA 70 and NECA NEIS 101.
  3. Type ENT: Article 362 of NFPA 70 and NECA NEIS 102.
  4. Type HDPE: Article 353 of NFPA 70 and NECA NEIS 111.
  5. Type ERMC-SS: Article 344 of NFPA 70 and NECA NEIS 101.
  6. Type ERMC-S: Article 344 of NFPA 70 and NECA NEIS 101.
  7. Type FMC-S: Article 348 of NFPA 70 and NECA NEIS 101.
  8. Type FMT: Article 360 of NFPA 70 and NECA NEIS 101.
  9. Type LFMC: Article 350 of NFPA 70 and NECA NEIS 101.
  10. Type LFNC: Article 342 of NFPA 70 and NECA NEIS 111.
  11. Type PVC: Article 356 of NFPA 70 and NECA NEIS 111.
  12. Expansion Fittings: NEMA FB 2.40.
  13. Consult Architect for resolution of conflicting requirements.
- C. Special Installation Techniques:
1. General Requirements for Installation of Duct Raceways:
    - a. Complete duct raceway installation before starting conductor installation.
    - b. Provide stub-ups through floors with coupling threaded inside for plugs, set flush with finished floor. Plug coupling until conduit is extended above floor to final destination or a minimum of 2 ft above finished floor.
    - c. Install no more than equivalent of three 90-degree bends in conduit run. Support within 12 inch of changes in direction.
    - d. Make bends in duct raceway using large-radius preformed ells except for parallel bends. Field bending must be in accordance with NFPA 70 minimum radii requirements. Provide only equipment specifically designed for material and size involved.
    - e. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
    - f. Support conduit within 12 inch of enclosures to which attached.
    - g. Install duct sealing fittings at accessible locations in accordance with NFPA 70 and fill them with listed sealing compound. For concealed duct raceways, install fitting in flush steel box with blank cover plate having finish similar to that of adjacent plates or surfaces. Install duct sealing fittings in accordance with NFPA 70.

- h. Install devices to seal duct raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal interior of duct raceways at the following points:
    - 1) Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
    - 2) Where an underground service duct raceway enters a building or structure.
    - 3) Conduit extending from interior to exterior of building.
    - 4) Conduit extending into pressurized duct raceway and equipment.
    - 5) Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
    - 6) Where otherwise required by NFPA 70.
  - i. Do not install duct raceways or electrical items on "explosion-relief" walls or rotating equipment.
  - j. Do not install conduits within 2 inch of the bottom side of a metal deck roof.
  - k. Keep duct raceways at least 6 inch away from parallel runs of flues and steam or hot-water pipes. Install horizontal duct raceway runs above water and steam piping.
  - l. Cut conduit perpendicular to the length. For conduits metric designator 53 (trade size 2) and larger, use roll cutter or a guide to make cut straight and perpendicular to the length. Ream inside of conduit to remove burrs.
  - m. Install pull wires in empty duct raceways. Provide polypropylene or monofilament plastic line with not less than 200 lb tensile strength. Leave at least 12 inch of slack at both ends of pull wire. Cap underground duct raceways designated as spare above grade alongside duct raceways in use.
  - n. Install duct raceways square to the enclosure and terminate at enclosures without hubs with locknuts on both sides of enclosure wall. Install locknuts hand tight, plus one-quarter turn more.
    - 1) Termination fittings with shoulders do not require two locknuts.
  - o. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to metric designator 35 (trade size 1-1/4) and insulated throat metal bushings on metric designator 41 (trade size 1-1/2) and larger conduits terminated with locknuts.
2. Types EMT-A, ERMC-A, and FMC-A: Do not install aluminum duct raceways.
  3. Types ERMC:
    - a. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound that maintains electrical conductivity to threads of duct raceway and fittings before making up joints. Follow compound manufacturer's published instructions.
  4. Types FMC, LFMC, and LFNC:
    - a. Provide a maximum of 72 inch of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

5. Types PVC, HDPE:
  - a. Do not install Type PVC, Type HDPE conduit where ambient temperature exceeds **122 deg F**. Conductor ratings must be limited to 75 deg C except where installed in a trench outside buildings with concrete encasement, where 90 deg C conductors are permitted.
  - b. Comply with manufacturer's published instructions for solvent welding and fittings.
6. Type RTRC: **Do not install Type RTRC conduit.**
7. Duct Raceways Embedded in Slabs:
  - a. Arrange duct raceways to cross building expansion joints with expansion fittings at right angles to the joint.
  - b. Arrange duct raceways to ensure that each is surrounded by minimum of **1 inch** of concrete without voids.
  - c. Do not embed threadless fittings in concrete unless locations have been specifically approved by Architect.
  - d. Change from ENT to **ERMC** before rising above floor.
8. Stub-ups to Above Recessed Ceilings:
  - a. Provide EMT for duct raceways.
  - b. Provide a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
9. Duct Raceway Terminations at Locations Subject to Moisture or Vibration:
  - a. Provide insulating bushings to protect conductors, including conductors smaller than 4 AWG. Install insulated throat metal grounding bushings on service conduits.
10. Duct Fittings: Install fittings in accordance with NEMA FB 2.10 guidelines.
  - a. ERMC-S-PVC: Provide only fittings listed for use with this type of conduit. Patch and seal joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Provide sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
  - b. EMT: Provide **setscrew, compression, steel, or cast-metal** fittings. Comply with NEMA FB 2.10.
  - c. Flexible Conduit: Provide only fittings listed for use with flexible conduit type. Comply with NEMA FB 2.20.
11. Expansion-Joint Fittings:
  - a. Install in runs of aboveground PVC that are located where environmental temperature change may exceed 30 deg F and that have straight-run length that exceeds 25 ft. Install in runs of aboveground ERMC and EMT conduit that are located where environmental temperature change may exceed 100 deg F and that have straight-run length that exceeds 100 ft.
  - b. Install type and quantity of fittings that accommodate temperature change listed for the following locations:



- 1) Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
  - 2) Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
  - 3) Indoor Spaces Connected with Outdoors without Physical Separation: **125 deg F** temperature change.
  - 4) Attics: 135 deg F temperature change.
- c. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
  - d. Install expansion fittings at locations where conduits cross building or structure expansion joints.
  - e. Install expansion-joint fitting with position, mounting, and piston setting selected in accordance with manufacturer's published instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
12. Duct Raceways Penetrating Rooms or Walls with Acoustical Requirements: Seal duct raceway openings on both sides of rooms or walls with acoustically rated putty **or firestopping**.
  13. Identification: Provide labels for conduit assemblies, duct raceways, and associated electrical equipment.
    - a. Provide warning signs.
- D. Interfaces with Other Work:
1. Coordinate installation of new products with existing conditions.
  2. Coordinate with Section 260529 "Hangers and Supports for Electrical Systems" for installation of conduit hangers and supports.

END OF SECTION 260533.13

## SECTION 260533.16 - BOXES AND COVERS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Metallic outlet boxes, device boxes, rings, and covers.
2. Nonmetallic outlet boxes, device boxes, rings, and covers.
3. Junction boxes and pull boxes.
4. Cover plates for device boxes.
5. Hoods for outlet boxes.

##### B. Products Installed, but Not Furnished, under This Section:

1. See Section 260553 "Identification for Electrical Systems" for electrical equipment labels.

##### C. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

#### 1.2 ACTION SUBMITTALS

##### A. Product Data:

1. Metallic outlet boxes, device boxes, rings, and covers.
2. Nonmetallic outlet boxes, device boxes, rings, and covers.
3. Junction boxes and pull boxes.
4. Cover plates for device boxes.
5. Hoods for outlet boxes.

##### B. Shop Drawings:

1. Shop drawings for floor boxes.

## PART 2 - PRODUCTS

### 2.1 BOXES, RINGS, AND COVERS

#### A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN QCIT; including UL 514A.

#### B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

#### C. UL QCIT - Metallic Outlet Boxes and Covers:

1. Description: Box having pryout openings, knockouts, threaded entries, or hubs in either the sides of the back, or both, for entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting outlet box cover, but without provisions for mounting wiring device directly to box.
2. Options:
  - a. Material: **Sheet steel.**
  - b. Sheet Metal Depth: Minimum 2.8 inch.

#### D. UL QCIT - Metallic Conduit Bodies:

1. Description: Means for providing access to interior of conduit or tubing system through one or more removable covers at junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Crouse-Hinds; brand of Eaton, Electrical Sector.
  - b. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - c. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.

#### E. UL QCIT - Metallic Device Boxes:

1. Description: Box with provisions for mounting wiring device directly to box.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.

- c. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - d. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
- 3. Options:
  - a. Material: **Sheet steel**
  - b. Sheet Metal Depth: minimum 2.8 inch.
- F. UL QCIT - Metallic Extension Rings:
  - 1. Description: Ring intended to extend sides of outlet box or device box to increase box depth, volume, or both.
  - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Cooper B-line; brand of Eaton, Electrical Sector.
    - b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    - c. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
- G. UL QCIT - Metallic Floor Boxes and Floor Box Covers:
  - 1. Description: Box mounted in floor with floor box cover and other components to complete floor box enclosure.
  - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. AFC Cable Systems; Atkore International.
    - b. Arlington Industries, Inc.
    - c. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    - d. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    - e. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    - f. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    - g. Wiremold; Legrand North America, LLC.
- H. UL QCIT - Metallic Raised-Floor Boxes and Floor Box Covers:
  - 1. Description: Box mounted in raised-floor with floor box cover and other components to complete floor box enclosure.
  - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ABB, Electrification Business.
    - b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.

c. Wiremold; Legrand North America, LLC.

I. UL QCIT - Metallic Recessed Access-Floor Boxes and Recessed Floor Box Covers:

1. Description: Floor box with provisions for mounting wiring devices below floor surface and floor box cover with provisions for passage of cords to recessed wiring devices mounted within floor box.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. FSR Inc.
  - b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - c. Wiremold; Legrand North America, LLC.

J. UL QCIT - Metallic Concrete Boxes and Covers:

1. Description: Box intended for use in poured concrete.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - b. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - c. Wiremold; Legrand North America, LLC.

2.2 NONMETALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. Listing Criteria: UL CCN QCMZ; including UL 514C.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

C. UL QCMZ - Nonmetallic Outlet Boxes and Covers:

1. Description: Box having pryout openings, knockouts, threaded entries, or hubs in either the sides or the back, or both, for entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting outlet box cover, but without provisions for mounting wiring device directly to box.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
- b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
- c. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
- d. Wiremold; Legrand North America, LLC.

D. UL QCMZ - Nonmetallic Conduit Bodies:

1. Description: Means for providing access to interior of conduit or tubing system through one or more removable covers at junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. ABB, Electrification Business.
  - b. Allied Tube & Conduit; Atkore International.
  - c. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.

E. UL QCMZ - Nonmetallic Device Boxes:

1. Description: Box with provisions for mounting wiring device directly to box.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. ABB, Electrification Business.
  - b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - c. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.

F. UL QCMZ - Nonmetallic Extension Rings:

1. Description: Ring intended to extend sides of outlet box or device box to increase box depth, volume, or both.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. ABB, Electrification Business.
  - b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - c. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.

G. UL QCMZ - Nonmetallic Floor Boxes and Floor Box Covers:

1. Description: Box mounted in floor with floor box cover and other components to complete floor box enclosure.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. ABB, Electrification Business.
  - b. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - c. Wiremold; Legrand North America, LLC.

H. UL QCMZ - Nonmetallic Concrete Boxes and Covers:

1. Description: Box intended for use in poured concrete.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. ABB, Electrification Business.
  - b. Allied Tube & Conduit; Atkore International.
  - c. Wiremold; Legrand North America, LLC.

2.3 JUNCTION BOXES AND PULL BOXES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. Listing Criteria: UL CCN BGUZ; including UL 50 and UL 50E.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

C. UL BGUZ - Indoor Sheet Metal Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Cooper B-line; brand of Eaton, Electrical Sector.
  - b. FSR Inc.
  - c. Hubbell Industrial Controls; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - d. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - e. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - f. Square D; Schneider Electric USA.

D. UL BGUZ - Outdoor Sheet Metal Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Cooper B-line; brand of Eaton, Electrical Sector.
  - b. FSR Inc.
  - c. Hubbell Industrial Controls; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - d. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - e. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - f. Square D; Schneider Electric USA.

## 2.4 COVER PLATES FOR DEVICES BOXES

### A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. Listing Criteria: UL CCN QCIT or UL CCN QCMZ; including UL 514D.
3. Wallplate-Securing Screws: Metal with head color to match wallplate finish.

### B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

### C. UL QCIT or QCMZ - Metallic Cover Plates for Device Boxes:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - c. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - d. Wiremold; Legrand North America, LLC.
2. Options:
  - a. Damp and Wet Locations: Listed, labeled, and marked for location and use. Provide gaskets and accessories necessary for compliance with listing.
  - b. Wallplate Material: **Galvanized steel** or as **indicated on architectural Drawings**.

### D. UL QCIT or QCMZ - Nonmetallic Cover Plates for Device Boxes:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:



- a. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - c. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - d. Wiremold; Legrand North America, LLC.
2. Options:
- a. Damp and Wet Locations: Listed, labeled, and marked for location and use. Provide gaskets and accessories necessary for compliance with listing.
  - b. Wallplate Material: **High-impact thermoplastic (nylon) with smooth finish and color matching wiring device** or as indicated on architectural Drawings.
  - c. Color: **Gray** or as indicated on architectural Drawings.

## 2.5 HOODS FOR OUTLET BOXES

### A. Performance Criteria:

- 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
- 2. Listing Criteria:
  - a. UL CCN QCIT or UL CCN QCMZ; including UL 514D.
  - b. Receptacle, Hood, Cover Plate, Gaskets, and Seals: UL 498 Supplement SA when mated with box or enclosure complying with UL 514A, UL 514C, or UL 50E.
- 3. Mounts to box using fasteners different from wiring device.

### B. Source Quality Control:

- 1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
- 2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

### C. UL QCIT or QCMZ - Retractable or Re-attachable Hoods for Outlet Boxes:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. ABB, Electrification Business.
  - b. Leviton Manufacturing Co., Inc.
  - c. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
- 2. Options:
  - a. Provides **clear**, weatherproof, "while-in-use" cover.

### D. UL QCIT or QCMZ - Extra-Duty, While-in-Use Hoods for Outlet Boxes:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. ABB, Electrification Business.
  - b. Leviton Manufacturing Co., Inc.
  - c. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
2. Additional Characteristics: Marked "Extra-Duty" in accordance with UL 514D.
3. Options:
  - a. Provides **clear**, weatherproof, "while-in-use" cover.
  - b. Manufacturer may combine nonmetallic device box with hood as extra-duty rated assembly.

## PART 3 - EXECUTION

### 3.1 PREPARATION

#### A. Shop Drawings: Prepare and submit the following:

1. Shop Drawings for Floor Boxes: Show that floor boxes are located to avoid interferences and are structurally allowable. Indicate floor thickness **at location** where boxes are embedded in concrete floors and underfloor clearances where boxes are installed in raised floors.

### 3.2 SELECTION OF BOXES AND COVERS FOR ELECTRICAL SYSTEMS

#### A. Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NFPA 70 for selection of boxes and enclosures. Consult Architect for resolution of conflicting requirements.

#### B. Degree of Protection:

##### 1. Outdoors:

- a. **Type 3R** unless otherwise indicated.
- b. Locations Aboveground Where Mechanism Must Operate When Ice Covered: Type 3S.

##### 2. Indoors:

- a. Type 1 unless otherwise indicated.

#### C. Exposed Boxes Installed Less Than 2.5 m (8 ft) Above Floor:

1. **Boxes with knockouts or unprotected openings are prohibited.**
2. Provide exposed cover. Flat covers with angled mounting slots or knockouts are prohibited.

### 3.3 INSTALLATION OF BOXES AND COVERS FOR ELECTRICAL SYSTEMS

- A. Comply with manufacturer's published instructions.
- B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturers' published instructions, comply with the following:
  - 1. Outlet, Device, Pull, and Junction Boxes: Article 314 of NFPA 70.
  - 2. Consult Architect for resolution of conflicting requirements.
- C. Special Installation Techniques:
  - 1. Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures.
  - 2. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to **center** of box unless otherwise indicated.
  - 3. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box, whether installed indoors or outdoors.
  - 4. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
  - 5. Locate boxes so that cover or plate will not span different building finishes.
  - 6. Support boxes in recessed ceilings independent of ceiling tiles and ceiling grid.
  - 7. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for purpose.
  - 8. Fasten junction and pull boxes to, or support from, building structure. Do not support boxes by conduits.
  - 9. Set metal floor boxes level and flush with finished floor surface.
  - 10. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.
  - 11. Do not install aluminum boxes, enclosures, or fittings in contact with concrete or earth.
  - 12. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to ensure a continuous ground path.
  - 13. Boxes and Enclosures in Areas or Walls with Acoustical Requirements:
    - a. Seal openings and knockouts in back and sides of boxes and enclosures with acoustically rated putty.
    - b. Provide gaskets for wallplates and covers.
  - 14. Identification: Provide labels for boxes and associated electrical equipment.
    - a. Identify field-installed conductors, interconnecting wiring, and components.
    - b. Provide warning signs.
    - c. Label each box with engraved metal or laminated-plastic nameplate.
- D. Interfaces with Other Work:

1. Coordinate installation of new products for with existing conditions.
2. Coordinate with Section 260573.13 "Short-Circuit Studies" for determining available fault current on input feeder.
3. Coordinate with Section 260573.19 "Arc-Flash Hazard Analysis" for determining arc-flash hazard on input feeder.

#### 3.4 CLEANING

- A. Remove construction dust and debris from boxes before installing wallplates, covers, and hoods.

#### 3.5 PROTECTION

- A. After installation, protect boxes from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 260533.16

## SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Round sleeves.
2. Rectangular sleeves.
3. Sleeve-seal systems.
4. Sleeve-seal fittings.
5. Grout.
6. Pourable sealants.
7. Foam sealants.

##### B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

#### 1.2 ACTION SUBMITTALS

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

### PART 2 - PRODUCTS

#### 2.1 ROUND SLEEVES

##### A. Steel Wall Sleeves:

1. General Characteristics: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, plain ends and integral waterstop.

##### B. Cast-Iron Wall Sleeves:

1. General Characteristics: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop.

##### C. PVC Pipe Sleeves:

1. General Characteristics: ASTM D1785, Schedule 40.

##### D. PVC Molded Sleeves:

1. General Characteristics: With nailing flange for attaching to wooden forms.
- E. PE or PP Molded Sleeves:
1. General Characteristics: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- F. Round, Galvanized-Steel, Sheet Metal Sleeves:
1. General Characteristics: Galvanized-steel sheet; thickness not less than 0.0239 inch; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

## 2.2 RECTANGULAR SLEEVES

- A. Rectangular, Galvanized-Steel, Sheet Metal Sleeves:
1. General Characteristics:
    - a. Material: Galvanized sheet steel.
    - b. Minimum Metal Thickness:
      - 1) For sleeve cross-section rectangle perimeter less than 50 inch and with no side larger than 16 inch, thickness must be 0.052 inch.
      - 2) For sleeve cross-section rectangle perimeter not less than 50 inch or with one or more sides larger than 16 inch, thickness must be 0.138 inch.

## 2.3 SLEEVE-SEAL SYSTEMS

- A. General Characteristics: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable or between raceway and cable.

## 2.4 SLEEVE-SEAL FITTINGS

- A. General Characteristics: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit must have plastic or rubber waterstop collar with center opening to match piping OD.

## 2.5 GROUT

- A. General Characteristics: Non-shrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
1. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
  2. Design Mix: 5000 psi, 28-day compressive strength.
  3. Packaging: Premixed and factory packaged.

## 2.6 POURABLE SEALANTS

### A. Performance Criteria:

1. General Characteristics: Single-component, neutral-curing elastomeric sealants of grade indicated below.
  - a. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

## 2.7 FOAM SEALANTS

### A. Performance Criteria:

1. General Characteristics: Multicomponent, liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam. Foam expansion must not damage cables or crack penetrated structure.

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF SLEEVES FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

#### A. Sleeves for Conduits Penetrating Above-Grade, Non-Fire-Rated, Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
  - a. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall or floor such that no voids remain. Tool exposed surfaces smooth; protect material while curing.
  - b. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint.
2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4 inch annular clear space between sleeve and raceway or cable, unless sleeve-seal system is to be installed **or seismic criteria require different clearance**.
4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
5. Install sleeves for floor penetrations. Extend sleeves installed in floors **2 inch** above finished floor level. Install sleeves during erection of floors.

#### B. Sleeves for Conduits Penetrating Non-Fire-Rated Wall Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for wall assemblies.

- C. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- D. Aboveground, Exterior-Wall Penetrations: Seal penetrations using **steel** pipe sleeves and mechanical sleeve-seal systems. Size sleeves to allow for 1 inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- E. Underground, Exterior-Wall and Floor Penetrations:
  - 1. Install **steel** pipe sleeves with integral waterstops. Size sleeves to allow for 1 inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system. Install sleeve during construction of floor or wall.
  - 2. Install steel pipe sleeves. Size sleeves to allow for 1 inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system. Grout sleeve into wall or floor opening.

### 3.2 INSTALLATION OF RECTANGULAR SLEEVES AND SLEEVE SEALS

- A. Install sleeves in existing walls without compromising structural integrity of walls. Do not cut structural elements without reinforcing the wall to maintain the designed weight bearing and wall stiffness.
- B. Install conduits and cable with no crossings within the sleeve.
- C. Fill opening around conduits and cables with expanding foam without leaving voids.
- D. Provide metal sheet covering at both wall surfaces and finish to match surrounding surfaces. Metal sheet must be same material as sleeve.

### 3.3 INSTALLATION OF SLEEVE-SEAL SYSTEMS

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

END OF SECTION 260544



PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Labels.
2. Bands and tubes.
3. Tapes and stencils.
4. Cable ties.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.

B. Identification Schedule: For each piece of electrical equipment and electrical system components to be index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with ASME A13.1 and IEEE C2.

B. Comply with 29 CFR 1910.144 for color identification of hazards; 29 CFR 1910.145 for danger, caution, warning, and safety instruction signs and tags; and the following:

1. Fire-protection **including raceways**, must be finished, painted, or suitably marked safety red.
2. Ceiling-mounted hangers, supports, cable trays, and raceways must be finished, painted, or suitably marked safety yellow where less than **7.7 ft** above finished floor.

C. Signs, labels, and tags required for personnel safety must comply with the following standards:

1. Safety Colors: NEMA Z535.1.
2. Facility Safety Signs: NEMA Z535.2.
3. Safety Symbols: NEMA Z535.3.
4. Product Safety Signs and Labels: NEMA Z535.4.
5. Safety Tags and Barricade Tapes for Temporary Hazards: NEMA Z535.5.

- D. Comply with NFPA 70E requirements for arc-flash warning labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, must comply with UL 969.
- F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
  - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

## 2.2 COLOR AND LEGEND REQUIREMENTS

- A. Raceways and Cables Carrying Circuits at 1000 V or Less:
  - 1. Black letters on orange field.
  - 2. Legend: Indicate voltage and system or service type.
- B. Color-Coding for Phase- and Voltage-Level Identification, 1000 V or Less: Use colors listed below for ungrounded feeder and branch-circuit conductors.
  - 1. Color must be factory applied
  - 2. Colors for 208Y/120 V Circuits:
    - a. Phase A: Black.
    - b. Phase B: Red.
    - c. Phase C: Blue.
  - 3. Colors for 240 V Circuits:
    - a. Phase A: Black.
    - b. Phase B: Red.
  - 4. Colors for 480Y/277 V Circuits:
    - a. Phase A: Brown.
    - b. Phase B: Orange.
    - c. Phase C: Yellow.
  - 5. Color for Neutral: White.
  - 6. Color for Equipment Grounds: Green.
- C. Raceways and Cables Carrying Circuits at More Than 1000 V:
  - 1. Black letters on orange field.
  - 2. Legend: "DANGER - CONCEALED HIGH VOLTAGE WIRING."
- D. Warning Label Colors:
  - 1. Identify system voltage with black letters on orange background.

E. Equipment Identification Labels:

1. Black letters on white field.
2. All equipment shall be identified with a black-on-clear printed adhesive label affixed where visible on the equipment. This label shall include the panel and branch circuit number supplying power to the equipment.

2.3 LABELS

- A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
- B. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.
- C. Self-Adhesive Wraparound Labels: Preprinted, 3 mil thick, **vinyl** flexible label with acrylic pressure-sensitive adhesive.
  1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over legend. Labels sized such that clear shield overlaps entire printed legend.
  2. Marker for Labels:
    - a. Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.
- D. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3 mil thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
  1. Minimum Nominal Size:
    - a. 1-1/2 by 6 inch for raceway and conductors.
    - b. 3-1/2 by 5 inch for equipment.
    - c. As required by authorities having jurisdiction.

2.4 BANDS AND TUBES

- A. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inch long, with diameters sized to suit diameters and that stay in place by gripping action.
- B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at maximum of 200 deg F. Comply with UL 224.

2.5 TAPES AND STENCILS

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mil thick by 1 to 2 inch wide; compounded for outdoor use.

- C. Tape and Stencil: 4 inch wide black stripes on 10 inch centers placed diagonally over orange background and are 12 inch wide. Stop stripes at legends.

## 2.6 CABLE TIES

- A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
  - 1. Minimum Width: 3/16 inch.
  - 2. Tensile Strength at 73 deg F in accordance with ASTM D638: 12,000 psi.
  - 3. Temperature Range: Minus 40 to plus 185 deg F.
  - 4. Color: Black, except where used for color-coding.
- B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
  - 1. Minimum Width: 3/16 inch.
  - 2. Tensile Strength at 73 deg F in accordance with ASTM D638: 12,000 psi.
  - 3. Temperature Range: Minus 40 to plus 185 deg F.
  - 4. Color: Black.
- C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.
  - 1. Minimum Width: 3/16 inch.
  - 2. Tensile Strength at 73 deg F in accordance with ASTM D638: 7000 psi.
  - 3. UL 94 Flame Rating: 94V-0.
  - 4. Temperature Range: Minus 50 to plus 284 deg F.
  - 5. Color: Black.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

### 3.2 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of item before installing identification products.

- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- G. System Identification for Raceways and Cables under 1000 V: Identification must completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
  - 1. Secure tight to surface of conductor, cable, or raceway.
- H. System Identification for Raceways and Cables over 1000 V: Identification must completely encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.
  - 1. Secure tight to surface of conductor, cable, or raceway.
- I. Vinyl Wraparound Labels:
  - 1. Secure tight to surface of raceway or cable at location with high visibility and accessibility.
- J. Self-Adhesive Wraparound Labels: Secure tight to surface at location with high visibility and accessibility.
- K. Self-Adhesive Labels:
  - 1. Install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
  - 2. Unless otherwise indicated, provide single line of text with 1/2 inch high letters on 1-1/2 inch high label; where two lines of text are required, use labels 2 inch high.
- L. Marker Tapes: Secure tight to surface at location with high visibility and accessibility.
- M. Self-Adhesive Vinyl Tape: Secure tight to surface at location with high visibility and accessibility.
  - 1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for minimum distance of 6 inch where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.
- N. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.
- O. Nonmetallic Preprinted Tags:
  - 1. Place in location with high visibility and accessibility.
- P. Laminated Acrylic or Melamine Plastic Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.
2. Unless otherwise indicated, provide single line of text with 1/2 inch high letters on 1-1/2 inch high sign; where two lines of text are required, use labels 2 inch high.

Q. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

### 3.3 IDENTIFICATION SCHEDULE

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.
- C. Accessible Raceways and Metal-Clad Cables, 1000 V or Less, for Service, Feeder, and Branch Circuits, More Than **100A** and **120V** to Ground: Identify with self-adhesive **raceway labels vinyl tape applied in bands**.
- D. Instructional Signs: Self-adhesive labels, including color code for grounded and ungrounded conductors.
- E. Arc Flash Warning Labeling: Self-adhesive labels.
- F. Equipment Identification Labels:
  1. Indoor Equipment: Self-adhesive label or Laminated acrylic or melamine plastic sign.
  2. Outdoor Equipment: Laminated acrylic or melamine sign.
  3. Equipment to Be Labeled:
    - a. Panelboards: Typewritten directory of circuits in location provided by panelboard manufacturer. Panelboard identification must be in form of laminated acrylic or melamine label.
    - b. Enclosures and electrical cabinets.
    - c. Access doors and panels for concealed electrical items.
    - d. Switchgear.
    - e. Switchboards.
    - f. Transformers: Label that includes tag designation indicated on Drawings for transformer, feeder, and panelboards or equipment supplied by secondary.
    - g. Substations.
    - h. Enclosed switches.
    - i. Enclosed circuit breakers.

END OF SECTION 260553

## SECTION 260573.13 - SHORT-CIRCUIT STUDIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Computer-based, fault-current study to determine minimum interrupting capacity of circuit protective devices.

##### B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
3. Section 260573.19 "Arc-Flash Hazard Analysis" for arc-flash studies.

#### 1.2 DEFINITIONS

- A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed and salvaged, or removed and reinstalled. Existing to remain items must remain functional throughout construction period.
- B. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion of the circuit from the system.
- D. SCCR: Short-circuit current rating.
- E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.
- F. Single-Line Diagram: See "One-Line Diagram."
- G. Short-Circuit Study Report:
1. Submit the following after approval of system protective devices submittals. Submittals must be in digital form.

- a. Short-circuit study input data, including completed computer program input data sheets.
- b. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.
- c. Revised one-line diagram, reflecting field investigation results and results of short-circuit study.

### 1.3 QUALITY ASSURANCE

- A. Study must be performed using commercially developed and distributed software designed specifically for power system analysis.
- B. Software algorithms must comply with requirements of standards and guides specified in this Section.
- C. Manual calculations are unacceptable.

## PART 2 - PRODUCTS

### 2.1 POWER SYSTEM ANALYSIS SOFTWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  1. SKM Systems Analysis, Inc.
  2. E-Tap Energy Management Solutions
  3. Aspen Inc.
- B. Comply with IEEE 399 and IEEE 551.
- C. Analytical features of power systems analysis software program must have capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- D. Computer software program must be capable of plotting and diagramming time-current-characteristic curves as part of its output.
- E. Computer program must be designed to perform short-circuit studies or have function, component, or add-on module designed to perform short-circuit studies.
- F. Computer program must be developed under supervision of licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.



## 2.2 SHORT-CIRCUIT STUDY REPORT CONTENTS

- A. Executive summary of study findings.
- B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
- C. One-line diagram of modeled power system, showing the following:
  - 1. Protective device designations and ampere ratings.
  - 2. Conductor types, sizes, and lengths.
  - 3. Transformer kVA and voltage ratings.
  - 4. Motor and generator designations and kVA ratings.
  - 5. Switchgear, switchboard, motor-control center, and panelboard designations and ratings.
  - 6. Derating factors and environmental conditions.
  - 7. Any revisions to electrical equipment required by study.
- D. Comments and recommendations for system improvements or revisions in written document, separate from one-line diagram.
- E. Protective Device Evaluation:
  - 1. Evaluate equipment and protective devices and compare to available short-circuit currents. Verify that equipment withstand ratings exceed available short-circuit current at equipment installation locations.
  - 2. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.
  - 3. For 600 V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
  - 4. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in standards to 1/2-cycle symmetrical fault current.
  - 5. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
- F. Short-Circuit Study Input Data:
  - 1. One-line diagram of system being studied.
  - 2. Power sources available.
  - 3. Manufacturer, model, and interrupting rating of protective devices.
  - 4. Conductors.
  - 5. Transformer data.
- G. Short-Circuit Study Output Reports:
  - 1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
    - a. Voltage.
    - b. Calculated fault-current magnitude and angle.

- c. Fault-point X/R ratio.
  - d. Equivalent impedance.
2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
- a. Voltage.
  - b. Calculated symmetrical fault-current magnitude and angle.
  - c. Fault-point X/R ratio.
  - d. Calculated asymmetrical fault currents:
    - 1) Based on fault-point X/R ratio.
    - 2) Based on calculated symmetrical value multiplied by 1.6.
    - 3) Based on calculated symmetrical value multiplied by 2.7.
3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
- a. Voltage.
  - b. Calculated symmetrical fault-current magnitude and angle.
  - c. Fault-point X/R ratio.
  - d. No AC Decrement (NACD) ratio.
  - e. Equivalent impedance.
  - f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on symmetrical basis.
  - g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on total basis.

## PART 3 - EXECUTION

### 3.1 POWER SYSTEM DATA

- A. Obtain data necessary for conduct of study.
  - 1. Verify completeness of data supplied on one-line diagram. Call discrepancies to Engineer's attention.
  - 2. For equipment included as Work of this Project, use characteristics submitted under provisions of action submittals and information submittals for this Project.
  - 3. For equipment that is existing to remain, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers in accordance with NFPA 70E.
- B. Gather and tabulate required input data to support short-circuit study. Comply with requirements in Section 017839 "Project Record Documents" for recording circuit protective device characteristics. Record data on Record Document copy of one-line diagram. Comply with recommendations in IEEE 551 as to amount of detail that is required to be acquired in field. Field data gathering must be by, or under supervision of, qualified electrical professional engineer. Data include, but are not limited to, the following:

1. Product Data for Project's overcurrent protective devices involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Obtain electrical power utility impedance at service.
3. Power sources and ties.
4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
5. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
6. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
7. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
8. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
9. Motor horsepower and NEMA MG 1 code letter designation.
10. Conductor sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
11. Derating factors.

### 3.2 SHORT-CIRCUIT STUDY

- A. Perform study following general study procedures contained in IEEE 399.
- B. Calculate short-circuit currents according to IEEE 551.
- C. Base study on device characteristics supplied by device manufacturer.
- D. Extent of electrical power system to be studied is indicated on Drawings.
- E. Begin short-circuit current analysis at service, extending down to system overcurrent protective devices as follows:
  1. To normal system low-voltage load buses where fault current is 5 kA or less.
  2. Exclude equipment supplied by single transformer smaller than 75 kVA.
- F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study cases of system-switching configurations and alternate operations that could result in maximum fault conditions.
- G. Include ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and apply to low- and medium-voltage, three-phase ac systems. Also account for fault-current dc decrement to address asymmetrical requirements of interrupting equipment.
- H. Calculate short-circuit momentary and interrupting duties for three-phase bolted fault and single line-to-ground fault at each equipment indicated on one-line diagram.
  1. For grounded systems, provide bolted line-to-ground fault-current study for areas as defined for three-phase bolted fault short-circuit study.

- I. Include in report identification of protective device applied outside its capacity.

END OF SECTION 260573.13

## SECTION 260573.19 - ARC-FLASH HAZARD ANALYSIS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Computer-based, arc-flash study to determine arc-flash hazard distance and incident energy to which personnel could be exposed during work on or near electrical equipment.

##### B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
3. Section 260573.13 "Short-Circuit Studies" for fault-current studies.

#### 1.2 DEFINITIONS

- A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.
- B. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.
- D. p.u.: Per unit. The reference unit, established as a calculating convenience, for expressing all power system electrical parameters on a common reference base.
- E. SCCR: Short-circuit current rating.
- F. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.
- G. Single-Line Diagram: See "One-Line Diagram."

#### 1.3 ACTION SUBMITTALS

##### A. Study Submittals:

1. Submit the following after approval of system protective devices submittals. Submittals **must** be in digital form:
  - a. Arc-flash study input data, including completed computer program input data sheets.
  - b. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.
  - c. Revised one-line diagram, reflecting field investigation results and results of arc-flash study.

#### 1.4 QUALITY ASSURANCE

- A. Study must be performed using commercially developed and distributed software designed specifically for power system analysis.
- B. Software algorithms must comply with requirements of standards and guides specified in this Section.
- C. Manual calculations are unacceptable.

#### 1.5 REGULATORY AGENCY APPROVALS

- A. Submittals for arc-flash hazard analysis requiring approval by authorities having jurisdiction must be signed and sealed by qualified electrical professional engineer responsible for their preparation.
- B. Submittals for arc-flash hazard analysis require action by Architect prior to submitting for approval by authorities having jurisdiction.

### PART 2 - PRODUCTS

#### 2.1 COMPUTER SOFTWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  1. SKM Systems Analysis, Inc.
  2. E-Tap Energy Management Solutions
  3. Aspen Inc.
- B. Comply with IEEE 1584 and NFPA 70E.

- C. Analytical features of device coordination study computer software program must have capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- D. Computer program must be designed to perform arc-flash analysis or have function, component, or add-on module designed to perform arc-flash analysis.
- E. Computer program must be developed under supervision of licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

## 2.2 ARC-FLASH STUDY REPORT CONTENT

- A. Executive summary of study findings.
- B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
- C. One-line diagram, showing the following:
  - 1. Protective device designations and ampere ratings.
  - 2. Conductor types, sizes, and lengths.
  - 3. Transformer kVA and voltage ratings, including derating factors and environmental conditions.
  - 4. Motor and generator designations and kVA ratings.
  - 5. Switchgear, switchboard, motor-control center, panelboard designations, and ratings.
- D. Study Input Data: As described in "Power System Data" Article.
- E. Short-Circuit Study Output Data: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260573.13 "Short-Circuit Studies."
- F. Protective Device Coordination Study Report Contents: As specified in "Coordination Study Report Contents" Article in Section 260573.16 "Coordination Studies."
- G. Arc-Flash Study Output Reports:
  - 1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each equipment location included in report:
    - a. Voltage.
    - b. Calculated symmetrical fault-current magnitude and angle.
    - c. Fault-point X/R ratio.
    - d. No AC Decrement (NACD) ratio.
    - e. Equivalent impedance.
    - f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on symmetrical basis.
    - g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on total basis.
- H. Incident Energy and Flash Protection Boundary Calculations:

1. Arcing fault magnitude.
  2. Protective device clearing time.
  3. Duration of arc.
  4. Arc-flash boundary.
  5. Restricted approach boundary.
  6. Limited approach boundary.
  7. Working distance.
  8. Incident energy.
  9. Hazard risk category.
  10. Recommendations for arc-flash energy reduction.
- I. Fault study input data, case descriptions, and fault-current calculations including definition of terms and guide for interpretation of computer printout.

### 2.3 ARC-FLASH WARNING LABELS

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for self-adhesive equipment labels. Produce 3.5 by 5 inch self-adhesive equipment label for each work location included in analysis.
- B. Label must have orange header with wording, "WARNING, ARC-FLASH HAZARD," and must include the following information taken directly from arc-flash hazard analysis:
1. Location designation.
  2. Nominal voltage.
  3. Protection boundaries.
    - a. Arc-flash boundary.
    - b. Restricted approach boundary.
    - c. Limited approach boundary.
  4. Arc flash PPE category.
  5. Required minimum arc rating of PPE in Cal/cm squared.
  6. Available incident energy.
  7. Working distance.
  8. Engineering report number, revision number, and issue date.
- C. Labels must be machine printed, with no field-applied markings.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.



### 3.2 ARC-FLASH HAZARD ANALYSIS

- A. Comply with NFPA 70E and its Annex D for hazard analysis study.
- B. Preparatory Studies: Perform Short-Circuit and Protective Device Coordination studies prior to starting Arc-Flash Hazard Analysis or obtain results from another source.
  - 1. Short-Circuit Study Output: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260573.13 "Short-Circuit Studies."
  - 2. Coordination Study Report Contents: As specified in "Coordination Study Report Contents" Article in Section 260573.16 "Coordination Studies."
- C. Calculate maximum and minimum contributions of fault-current size.
  - 1. Maximum calculation must assume maximum contribution from utility and must assume motors to be operating under full-load conditions.
  - 2. Calculate arc-flash energy at 85 percent of maximum short-circuit current in accordance with IEEE 1584 recommendations.
  - 3. Calculate arc-flash energy at 38 percent of maximum short-circuit current in accordance with NFPA 70E recommendations.
  - 4. Calculate arc-flash energy with utility contribution at minimum and assume no motor contribution.
- D. Calculate arc-flash protection boundary and incident energy at locations in electrical distribution system where personnel could perform work on energized parts.
- E. Include medium- and low-voltage equipment locations, except equipment fed from transformers smaller than 75 kVA.
- F. Calculate limited, restricted, and prohibited approach boundaries for each location.
- G. Incident energy calculations must consider accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations must take into account changing current contributions, as sources are interrupted or decremented with time. Fault contribution from motors and generators must be decremented as follows:
  - 1. Fault contribution from induction motors must not be considered beyond three to five cycles.
  - 2. Fault contribution from synchronous motors and generators must be decayed to match actual decrement of each as closely as possible (for example, contributions from permanent magnet generators will typically decay from 10 p.u. to 3 p.u. after 10 cycles).
- H. Arc-flash energy must generally be reported for maximum of line or load side of circuit breaker. However, arc-flash computation must be performed and reported for both line and load side of circuit breaker as follows:
  - 1. When circuit breaker is in separate enclosure.
  - 2. When line terminals of circuit breaker are separate from work location.

- I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

### 3.3 POWER SYSTEM DATA

- A. Obtain data necessary for conduct of arc-flash hazard analysis.
  1. Verify completeness of data supplied on one-line diagram on Drawings Call discrepancies to Engineer's attention.
  2. For new equipment, use characteristics from approved submittals under provisions of action submittals and information submittals for this Project.
  3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys conducted by qualified technicians and engineers.
- B. Electrical Survey Data: Gather and tabulate the following input data to support study. Comply with recommendations in IEEE 1584 and NFPA 70E as to amount of detail that is required to be acquired in field. Field data gathering must be under direct supervision and control of engineer in charge of performing study, and must be by, or under supervision of, qualified electrical professional engineer. Data include, but are not limited to, the following:
  1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
  2. Obtain electrical power utility impedance or available short circuit current at service.
  3. Power sources and ties.
  4. Short-circuit current at each system bus (three phase and line to ground).
  5. Full-load current of loads.
  6. Voltage level at each bus.
  7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
  8. For reactors, provide manufacturer and model designation, voltage rating and impedance.
  9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
  10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
  11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
  12. Busway manufacturer and model designation, current rating, impedance, lengths, size, and conductor material.
  13. Motor horsepower and NEMA MG 1 code letter designation.
  14. Low-voltage conductor sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
  15. Medium-voltage conductor sizes, lengths, conductor material, conductor construction and metallic shield performance parameters, and conduit material (magnetic or nonmagnetic).

### 3.4 LABELING

- A. Apply **one** arc-flash label on front cover of each section of equipment and on side or rear covers with accessible live parts and hinged doors or removable plates for each equipment included in study. Base arc-flash label data on highest values calculated at each location.
- B. Each piece of equipment listed below not fed by single transformer smaller than 75 kVA must have arc-flash label applied to it:
  - 1. Medium-voltage switchgear.
  - 2. Medium-voltage switches.
  - 3. Medium voltage transformers.
  - 4. Low-voltage switchgear.
  - 5. Switchboards.
  - 6. Panelboards.
  - 7. Motor-control centers.
  - 8. Low voltage transformers.
  - 9. Safety switches.
  - 10. Control panels.
- C. Note on record Drawings location of equipment where personnel could be exposed to arc-flash hazard during their work.
  - 1. Indicate arc-flash energy.
  - 2. Indicate protection level required.

### 3.5 APPLICATION OF WARNING LABELS

- A. Install arc-flash warning labels under direct supervision and control of qualified electrical professional engineer.

END OF SECTION 260573.19

## SECTION 262416 - PANELBOARDS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Power panelboards.
2. Lighting and appliance branch-circuit panelboards.
3. Load centers.
4. Disconnecting and overcurrent protective devices.

##### B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

#### 1.2 DEFINITIONS

A. GFEP: Ground-fault equipment protection.

B. MCCB: Molded-case circuit breaker.

C. VPR: Voltage protection rating.

#### 1.3 ACTION SUBMITTALS

##### A. Product Data:

1. Power panelboards.
2. Lighting and appliance branch-circuit panelboards.
3. Load centers.
4. Disconnecting and overcurrent protective devices.
5. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
6. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

##### B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details.
2. Detail bus configuration, current, and voltage ratings.

3. Short-circuit current rating of panelboards and overcurrent protective devices.
4. Include evidence of listing, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for series rating of installed devices.
5. Include evidence of listing, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for SPD as installed in panelboard.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Include wiring diagrams for power, signal, and control wiring.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Warranty documentation.

#### 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Spare Parts: Furnish to Owner spare parts, for repairing panelboards, that are packaged with protective covering for storage on-site and identified with labels describing contents. Include the following:
  1. Keys: Two (2) spares for each type of panelboard cabinet lock.
  2. Circuit Breakers Including GFCI and GFEP Types: Two (2) spares for each panelboard.
  3. Fuses for Fused Switches: Equal to 10 percent (10%) of quantity installed for each size and type, but no fewer than three (3) of each size and type.
  4. Fuses for Fused Power-Circuit Devices: Equal to 10 percent (10%) of quantity installed for each size and type, but no fewer than three (3) of each size and type.
- B. Special Tools: Furnish to Owner proprietary equipment, keys, and software required to operate, maintain, repair, adjust, or implement future changes to panelboards, that are packaged with protective covering for storage on-site and identified with labels describing contents.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards.

#### 1.8 WARRANTY

- A. Special Installer Extended Warranty: Installer warrants that fabricated and installed panelboards perform in accordance with specified requirements and agrees to repair or replace components or products that fail to perform as specified within extended-warranty period.
  1. Extended-Warranty Period: Five (5) years from date of Substantial Completion; full coverage for labor, materials, and equipment.

- B. Special Manufacturer Extended Warranty: Manufacturer warrants that panelboards perform in accordance with specified requirements and agrees to provide repair or replacement of components or products that fail to perform as specified within extended-warranty period.
  - 1. Extended-Warranty Period: Five (5) years from date of Substantial Completion; full coverage for labor, materials, and equipment.

## PART 2 - PRODUCTS

### 2.1 EXISTING PRODUCTS TO BE REMOVED AND REPLACED AS INDICATED ON THE DRAWINGS.

### 2.2 PANELBOARDS AND LOAD CENTERS COMMON REQUIREMENTS

- A. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- B. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing agency recognized by authorities having jurisdiction, and marked for intended location and application.
- C. Comply with NEMA PB 1.
- D. Comply with NFPA 70.
- E. Enclosures: Flush and Surface-mounted, dead-front cabinets.
  - 1. Rated for environmental conditions at installed location.
    - a. Indoor Dry and Clean Locations: UL 50E, Type 1.
    - b. Outdoor Locations: UL 50E, Type 3R.
  - 2. Height: 7 ft maximum.
  - 3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims must cover live parts and may have no exposed hardware.
  - 4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims must cover live parts and may have no exposed hardware.
  - 5. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
  - 6. Finishes:
    - a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
    - b. Back Boxes: Same finish as panels and trim.
- F. Incoming Mains:

1. Location: Convertible between top and bottom.
  2. Main Breaker: Main lug interiors up to 400 A must be field convertible to main breaker.
- G. Phase, Neutral, and Ground Buses:
1. Material: Hard-drawn copper, 98 percent (98%) conductivity.
    - a. Bus must be fully rated for entire length.
  2. Interiors must be factory assembled into unit. Replacing switching and protective devices may not disturb adjacent units or require removing main bus connectors.
  3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
  4. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
  5. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure.
  6. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and listed and labeled, by qualified electrical testing laboratory recognized by authorities having jurisdiction, as suitable for nonlinear loads in electronic-grade panelboards and others designated on Drawings. Connectors must be sized for double-sized or parallel conductors as indicated on Drawings.
  7. Split Bus: Vertical buses divided into individual vertical sections.
- H. Conductor Connectors: Suitable for use with conductor material and sizes.
1. Material: Tin-plated aluminum.
  2. Terminations must allow use of 75 deg C rated conductors without derating.
  3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
  4. Main and Neutral Lugs: Compression type, with lug on neutral bar for each pole in panelboard.
  5. Ground Lugs and Bus-Configured Terminators: Compression type, with lug on bar for each pole in panelboard.
  6. Feed-Through Lugs: Compression type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
  7. Extra-Capacity Neutral Lugs: Rated 200 percent (200%) of phase lugs mounted on extra-capacity neutral bus.
- I. Quality-Control Label: Panelboards or load centers must be labeled, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards or load centers must have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.
- J. Future Devices: Panelboards or load centers must have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
1. Percentage of Future Space Capacity: minimum **5** percent.
- K. Panelboard Short-Circuit Current Rating:

1. Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by qualified electrical testing laboratory recognized by authorities having jurisdiction. Include label or manual with size and type of allowable upstream and branch devices listed and labeled, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for series-connected short-circuit rating.
  - a. Panelboards rated 240 V or less must have short-circuit ratings as shown on Drawings, but not less than 10 000 A(rms) symmetrical.
  - b. Panelboards rated above 240 V and less than 600 V must have short-circuit ratings as shown on Drawings, but not less than 14 000 A(rms) symmetrical.
2. Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for 100 percent interrupting capacity.
  - a. Panelboards and overcurrent protective devices rated 240 V or less must have short-circuit ratings as shown on Drawings, but not less than 10 000 A(rms) symmetrical.
  - b. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V must have short-circuit ratings as shown on Drawings, but not less than 14 000 A(rms) symmetrical.

### 2.3 POWER PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. ABB, Electrification Business.
  2. Eaton.
  3. Square D; Schneider Electric USA.
- B. Listing Criteria: NEMA PB 1, distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
  1. For doors more than 36 inch high, provide two latches, keyed alike.
- D. Mains: Circuit breaker or Main lug.
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Plug-in circuit breakers or Bolt-on circuit breakers.
- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.
- G. Branch Overcurrent Protective Devices: Fused switches.



## 2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. ABB, Electrification Business.
  - 2. Eaton.
  - 3. Square D; Schneider Electric USA.
- B. Listing Criteria: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker or Main lug.
- D. Branch Overcurrent Protective Devices: Plug-in or Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Door-in-door construction with concealed hinges; secured with flush or multipoint latch with tumbler lock; keyed alike. Outer door must permit full access to panel interior. Inner door must permit access to breaker operating handles and labeling, but current carrying terminals and bus must remain concealed.

## 2.5 INTELLIGENT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. ABB, Electrification Business.
  - 2. Eaton.
  - 3. Square D; Schneider Electric USA.
- B. The manufacturer shall provide one-day, on-site start up and training.
- C. Listing Criteria: Comply with UL 67.
- D. Mains: Circuit breaker or Main lug.
- E. Intelligent panelboards shall use standard boxes, interiors, and trims. Panelboard shall not require different construction to accommodate control components. All control components shall install onto standard panelboard interiors. Control components shall not restrict field wiring in gutter space.
- F. All intelligent panelboards shall be provided with remotely operated circuit breakers and intelligent control bus providing interface to remotely operable circuit breakers. Panelboards shall accept a mix of standard and remotely operated circuit breakers.
- G. The intelligent panelboard system shall fully accommodate the separation of Class 1 and Class 2 control circuits as required by the NEC. The control bus shall be a UL-listed Class 1 control device for installation in the same panelboard gutter with field-installed power circuits. Intelligent panelboards using control bus devices that are not specifically listed as UL Class 1 shall be provided with physical barriers to completely separate field wiring from the control bus, circuit breaker connections, and all associated Class 2 wiring.

- H. Intelligent panelboard systems shall be comprised of master and optional sub-panel panelboards.
1. Master intelligent panelboards shall be further provided with a system power supply and a controller with integral time clock. Master panelboards shall not require manually setting a sub-panel address.
  2. Sub-panel panelboards shall obtain control power and control signals from the master panelboard or a separate, remotely-mounted controller and power supply.
    - a. Sub-panel panelboards shall be provided with an easily readable and settable numeric address wheel. Systems with binary-coded DIP-switch address selectors shall not be accepted.
    - b. Panelboards marked as sub-panel panelboards shall contain the necessary busses and network hardware to allow connection of the sub-net wiring between panelboards.
    - c. Sub-panel panelboards shall contain a nameplate label, located on the panel trim indicating its designation and the designations and address of its associated master panel.
    - d. Sub-net wiring connections shall allow connection of wiring to a terminal that can be removed from the panel without interrupting the communications to other panelboards.
    - e. Powered sub-panel panelboards shall further include a power supply to extend capacity of the system.
- I. System Power Supply: The system power supply shall mount on the panelboard interior and be fed directly from the panelboard bus without external wiring or fuses. The power supply shall provide isolated Class 1 and Class 2 sources to allow field wiring to meet NEC requirements. Each power supply shall provide capacity for 8 control busses with 168 circuit breakers in up to 8 panelboards, and one controller.
- J. Remotely Operated Circuit Breakers
1. Remotely operated branch circuit breakers shall provide overload and short circuit protection suitable for the location in the electrical system, as defined in the panelboard schedules. Remotely operated power switching devices shall have the following:
  2. Integral branch circuit overcurrent protection as required by the NEC. Circuit breakers shall have a UL-listed interrupting rating sufficient for the application or UL-listed series connected ratings for the maximum available fault current at that point in the system. Submittals reflecting the use of relays or contactors to perform remote switching shall show evidence in writing that the relays or contactors are listed to withstand the available fault current.
  3. UL-listed SWD ratings for 15 ampere, 20 ampere, and 30 ampere 1-pole, 2-pole, and 3-pole branch devices, HID ratings, and HACR ratings.
  4. Handle operator that shall mechanically open the power switching device contacts when moved to the OFF position and disable the contacts from being remotely closed. Handle

operator shall accept field-installable handle tie to allow application where a handle tie is required by the NEC.

5. Manual override switch to enable or disable the remote operation of the device and allow circuit breaker handle to fully control the on/off state of the circuit breaker. Override shall fully disengage remote operation of the circuit breaker mechanism. Device utilizing one-shot or temporary overrides shall not be accepted.
6. Visible flag that clearly indicates the status of the circuit breaker contacts with the panel trim installed. Flag shall indicate ON, OFF, and TRIPPED circuit breaker states. The visible flag shall be mechanical in nature, directly tied to the circuit breaker mechanism, and shall be provided in addition to any status indicator supplied by the system electronics.
7. Voltage status signal to indicate the presence or absence of voltage at the load terminal as a true indication of the on/off status of the connected circuit to aid in identifying wiring errors, such as a back-feed or disconnected neutral conductor.
8. Circuit to indicate the number of poles of the remotely operable circuit breaker.
9. Integral control connector to simplify and speed installation and eliminate wiring errors such that the control connection is made automatically when installing the breaker in the panelboard. Connection to the breaker shall not introduce control wiring into the panelboard gutter space. Control connections shall be rated NEC Class 1 to eliminate the requirement for barriers in the gutter space such that control connections may reside with electrical power circuit conductors.

K. Master panelboard controller

1. The master panelboard controller shall provide the following:
2. Logical control capability for 336 remotely controllable circuit breakers.
3. Auxiliary control power source for powering external control devices such as occupancy sensors and low voltage photo sensors, as indicated on the Drawings.
4. Programmable input timers to permit timed override periods.
5. Adjustable blink notice.
6. Event logging to track circuit breaker, input, and zone state; schedule periods; bus operational status; and circuit breaker on-time.
7. Capability for accepting downloadable firmware without removing controller.
8. Time scheduling including, but not limited to, the following:
  - a. Sixty-four (64) independent schedules, each configurable into 100 distinct periods.
  - b. Clock configurable for 12-hour (AM/PM) or 24-hour format. Clock shall retain time for at least 21 days in the absence of power. Clock back-up circuit shall be maintenance free.
  - c. Schedule periods settable to the minute.
  - d. 365-day calendar, with automatic daylight savings and leap year adjustments.
  - e. Day-of-week, day-of-month, day-of-year with one-time or repeating capability.
  - f. Ninety-six (96) special event periods with 14 pre-programmed holidays.

- g. Astronomical tracker to automatically adjust sunrise and sunset times throughout the year.
- 9. Sixteen hard-wired terminals configurable for either 16 two-wire inputs, eight three-wire inputs, or eight two-wire inputs with status feedback for pilot LED's (four Analog input terminals, each configurable to 0-5v, 0-10v, or 4-20ma with 256 possible thresholds). Configurations shall allow either momentary or maintained control devices to be attached. These inputs shall be configured according to the Owner's requirements and shall be capable of providing the following capabilities:
  - a. Two-hundred-fifty-six (256) communication inputs available for network connections.
  - b. Input synchronization service to synch inputs with other inputs, zones, time schedules, or remote sources. This synchronization service shall be used to control input state, input inhibit mode (enable/disable), or sync timers (enable/disable).
  - c. Boolean custom controls, including, but not limited to, configuring sources. Sources shall include, but shall not be limited to, inputs, time schedules, or status. Up to four sources shall be permitted in a custom configurable logic arrangement configured up to 256 zones.
- 10. Zone priorities, assignable to each zone, such that the particular zone shall have priority over other zones. Zones priorities shall be capable of forcing all circuit breakers in the zone to an ON state or an OFF state depending on the particular configuration.
- 11. Ethernet communications. Each panel controller shall allow networking with other master panel controllers in a peer-to-peer configuration using an Ethernet 100Base-T full duplex network.
  - a. Each panel controller shall support three (3) Ethernet ports communicating using Modbus TCP/IP and/or BACnet/IP protocols.
  - b. Each input connected to the controller shall be capable of controlling any branch circuit connected to any other controller.
  - c. A schedule programmed in one controller shall be capable of controlling any branch circuit connected to any other controller.
  - d. Means for setting initial Ethernet parameters via a local operator interface without having to employ special software or configuration tools.
  - e. Each panel controller shall be capable of operating in a pass-through mode for Modbus connected devices, such as meters, whereby the information is automatically ported to the Modbus TCP/IP port without separate gateway devices.
- 12. Each panel controller shall incorporate a time synchronization service to update controller clock to a network time server. The time synchronization service shall incorporate both a primary and secondary source. The update interval shall be settable from 1 to 24 hours.
- 13. Embedded web server. Each panel controllers shall incorporate a web-enabled server for displaying information over a standard web browser. Web-accessible information shall include:
  - a. A secure, password protected login screen for modifying operational parameters to ensure only authorized access. Password administration shall be accessible to authorized users via web page interface.

- b. Separate web pages for each panel with the arrangement of circuit breakers on the page matching the physical appearance of the panel. Panel status pages shall also include, but shall not be limited to, circuit breaker nametags, pole configuration, location in panel, and actual contact state (on/off/tripped/manual) for the master panel and each associated sub- panel. The web page shall also provide the ability to observe circuit breaker on-time and blink information in real time.
  - c. Panel summary showing the master and sub-panel panelboards connected to the controller.
  - d. Controller summary showing controller diagnostic information.
  - e. Panel mimic screens for setting up controller parameters, input types, zones, and operating schedules. Mimic screens shall also allow direct circuit breaker control and zone overrides.
  - f. Alarm and email notification. Each master controller shall incorporate an alarm and automated email notification service. These services shall be capable of automatically initiating alarms based on preconfigured conditions and routing alarm alerts as directed by the Owner.
14. Alarms shall be configurable for the following parameters:
- a. Global alarms (power loss, non-responding circuit breakers, loss and restoration of sub-net communications, loss and restoration of serial port communications, and loss and restoration of Modbus TCP Ethernet commands).
  - b. Specific alarms (input status, zone status, circuit breaker status on-time (0 to 99,999 hours), and strike counter).
  - c. Email notification service shall include, but shall not be limited to, the ability to automatically route an email message to five individual email addresses. Within the body text of the email, provide a link that shall automatically redirect the user to the associated panelboard's status web page.
15. BACnet Conformance:
- a. Reference BACnet Standard, ASHRAE 135.
  - b. Each panel controller shall, at a minimum, support serial BACnet MS/TP and Ethernet BACnet/IP communications.
  - c. Each panel controller shall be able to communicate directly via BACnet RS-485 serial networks and Ethernet 100Base-T networks as a native BACnet device.
  - d. Each panel controller shall comply with Annex J of ASHRAE 135 for IP connections.
  - e. Each panel controller shall function as a BACnet application specific controller in accordance with Annex L of ASHRAE 135, and shall support the following BACnet interoperability building blocks:
    - 1) Data Sharing - Read Property - B.
    - 2) Data Sharing - Read Property Multiple - B.
    - 3) Data Sharing - Write Property - B.
    - 4) Data Sharing - Write Property Multiple - B.
    - 5) Device Management - Dynamic Device Binding - B.
    - 6) Device Management - Dynamic Object Binding - B.
    - 7) Device Management - Device Communication Control - B.

- 8) Device Management - Time Synchronization - B.
  - 9) Device Management - UTC Time Synchronization - B.
  - 10) Device Management - Reinitialize Device - B.
- f. Standard BACnet object types supported shall include, but shall not be limited to, analog value, binary value, multi-state value, and multi-state output.
16. Optical isolation: The controller shall provide a dedicated, optically-isolated RS-485 port for connection to Class 1 control busses in master and sub-panel panelboards. Systems without physical barriers between power and Class 2 circuits shall provide an optical isolator between controller and control uses and a separate power source to the controller.

## 2.6 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, **provide products by one of the following**:
- 1. ABB, Electrification Business.
  - 2. Eaton.
  - 3. Square D; Schneider Electric USA.
- B. MCCB: Comply with UL 489, with **series-connected rating** to meet available fault currents.
- 1. Thermal-Magnetic Circuit Breakers:
    - a. Inverse time-current element for low-level overloads.
    - b. Instantaneous magnetic trip element for short circuits.
    - c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
  - 3. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
  - 4. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6 mA trip).
  - 5. GFEP Circuit Breakers: Class B ground-fault protection (30 mA trip).
  - 6. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240 V, single-pole configuration.
  - 7. Subfeed Circuit Breakers: Vertically mounted.
  - 8. MCCB Features and Accessories:
    - a. Standard frame sizes, trip ratings, and number of poles.
    - b. Breaker handle indicates tripped status.
    - c. UL listed for reverse connection without restrictive line or load ratings.
    - d. Lugs: **Compression** style, suitable for number, size, trip ratings, and conductor materials.
    - e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.

- f. Ground-Fault Protection: **Integrally mounted** relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
  - g. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.
- C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
- 1. Fuses and Spare-Fuse Cabinet: Comply with requirements specified in Section 262813 "Fuses."
  - 2. Fused Switch Features and Accessories:
    - a. Standard ampere ratings and number of poles.
    - b. Mechanical cover interlock with manual interlock override, to prevent opening of cover when switch is in on position. Interlock must prevent switch from being turned on with cover open. Operating handle must have lock-off means with provisions for three padlocks.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.
- B. Receive, inspect, handle, and store panelboards in accordance with NEMA PB 1.1.
- C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.
- D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Comply with manufacturer's published instructions.
- B. Reference Standards:
  - 1. Panelboards: Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with **NEMA PB 1.1**.
  - 2. Consult Architect for resolution of conflicting requirements.
- C. Special Techniques:
  - 1. Equipment Mounting:
    - a. Attach panelboard to vertical finished or structural surface behind panelboard.

2. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
3. Mount top of trim **7.5 ft** above finished floor unless otherwise indicated.
4. Mount panelboard cabinet plumb and rigid without distortion of box.
5. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
6. Install overcurrent protective devices and controllers not already factory installed.
  - a. Set field-adjustable, circuit-breaker trip ranges.
  - b. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver in accordance with manufacturer's published instructions.
7. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
8. Install filler plates in unused spaces.
9. Arrange conductors in gutters into groups and bundle and wrap with wire ties **after completing load balancing.**
10. Mount spare fuse cabinet in accessible location.

D. Interfaces with Other Work:

1. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

### 3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."
- B. Panelboard Nameplates: Label each panelboard with nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- C. Device Nameplates: Label each branch circuit device in power panelboards with nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- D. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.
- E. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles must be located on interior of panelboard door.
- F. Breaker Labels: Faceplate must list current rating, UL and IEC certification standards, and AIC rating.



G. Circuit Directory:

1. Provide directory card inside panelboard door, mounted in transparent card holder or metal frame with transparent protective cover.
  - a. Circuit directory must identify specific purpose with detail sufficient to distinguish it from other circuits.
2. Provide **typed** circuit directory mounted inside panelboard door with transparent plastic protective cover.
  - a. Circuit directory must identify specific purpose with detail sufficient to distinguish it from other circuits.
3. Create directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

3.4 ADJUSTING

- A. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Architect of effect on phase color coding.
1. Measure loads during period of normal facility operations.
  2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by Architect. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
  3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
  4. Tolerance: Maximum difference between phase loads, within panelboard, may not exceed 20 percent.

END OF SECTION 262416

## SECTION 262813 - FUSES

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Cartridge fuses rated 600 V ac and less for use in the following:
  - a. Switchboards.
2. Spare-fuse cabinets.

#### 1.2 ACTION SUBMITTALS

##### A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
  - a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
  - b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
3. Current-limitation curves for fuses with current-limiting characteristics.
4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit in PDF format.
5. Coordination charts and tables and related data.
6. Fuse sizes for elevator feeders and elevator disconnect switches.

#### 1.3 CLOSEOUT SUBMITTALS

1. Ambient temperature adjustment information.
2. Current-limitation curves for fuses with current-limiting characteristics.
3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse used on the Project. Submit in PDF format.
4. Coordination charts and tables and related data.

#### 1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Fuses: Equal to **10** percent of quantity installed for each size and type, but no fewer than **three** of each size and type.

#### 1.5 FIELD CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than **40 deg F** or more than **100 deg F** apply manufacturer's ambient temperature adjustment factors to fuse ratings.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Bussmann; Eaton, Electrical Sector.
  - 2. Mersen USA.
- B. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

#### 2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.
  - 1. Type RK-1: **600-V**, zero- to 600-A rating, 200 kAIC.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.
- E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

#### 2.3 SPARE-FUSE CABINET

- A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.

1. Size: Adequate for storage of spare fuses specified with ten percent (10%) spare capacity minimum.
2. Finish: Gray, baked enamel.
3. Identification: "SPARE FUSES" in 1-1/2-inch-high letters on exterior of door.
4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Install spare-fuse cabinet(s) in location shown on the Drawings.

### 3.3 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Molded-case circuit breakers (MCCBs).
3. Enclosures.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.2 DEFINITIONS

- A. GFEP: Ground-fault circuit-interrupter for equipment protection.
- B. GFLS: Ground-fault circuit-interrupter for life safety.
- C. SPDT: Single pole, double throw.

1.3 ACTION SUBMITTALS

A. Product Data:

1. For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
2. Enclosure types and details for types other than UL 50E, Type 1.
3. Current and voltage ratings.
4. Short-circuit current ratings (interrupting and withstand, as appropriate).
5. Include evidence of qualified electrical testing laboratory listing for series rating of installed devices.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

B. Shop Drawings: For enclosed switches and circuit breakers.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include wiring diagrams for power, signal, and control wiring.

C. Field Quality-Control Submittals:

1. Field quality-control reports.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Warranty documentation.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Spare Parts: Furnish to Owner spare parts, for repairing enclosed switches and circuit breakers, that are packaged with protective covering for storage on-site and identified with labels describing contents. Include the following:

1. Fuses: Equal to ten percent (10%) of quantity installed for each size and type, but no fewer than three (3) of each size and type.
2. Fuse Pullers: Two (2) for each size and type.

1.7 WARRANTY

- A. Special Installer Extended Warranty: Installer warrants that fabricated and installed enclosed switches and circuit breakers perform in accordance with specified requirements and agrees to repair or replace components or products that fail to perform as specified within extended-warranty period.

1. Extended-Warranty Period: Two years from date of Substantial Completion; full coverage for labor, materials, and equipment.

- B. Special Manufacturer Extended Warranty: Manufacturer warrants that enclosed switches and circuit breakers perform in accordance with specified requirements and agrees to provide repair or replacement of components or products that fail to perform as specified within extended-warranty period.

1. Extended-Warranty Period: Three years from date of Substantial Completion; **full** coverage for labor, materials, and equipment.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Source Limitations: Obtain products from single manufacturer.

- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

## 2.2 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. ABB, Electrification Business.
  - 2. Eaton.
  - 3. Square D; Schneider Electric USA.
- B. Type HD, Heavy Duty:
  - 1. **Single** throw.
  - 2. **Three** pole.
  - 3. 600V(ac).
  - 4. 1200 A and smaller.
  - 5. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
  - 1. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
  - 2. Lugs: Compression type, suitable for number, size, and conductor material.

## 2.3 MOLDED-CASE CIRCUIT BREAKERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. ABB, Electrification Business.
  - 2. Eaton.
  - 3. Square D; Schneider Electric USA.
- B. Circuit breakers must be constructed using glass-reinforced insulating material. Current carrying components must be completely isolated from handle and accessory mounting area.
- C. Circuit breakers must have toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. Circuit-breaker handle must be over center, be trip free, and reside in tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon must be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with push-to-trip button, located on face of circuit breaker to mechanically operate circuit-breaker tripping mechanism for maintenance and testing purposes.

- D. Maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings must be clearly marked on face of circuit breaker. Circuit breakers must be 100 percent rated as indicated on Drawings.
- E. MCCBs must be equipped with device for locking in isolated position.
- F. Lugs must be suitable for 90 deg C rated wire, sized in accordance with 75 deg C temperature rating in NFPA 70.
- G. Standard: Comply with UL 489 with required interrupting capacity for available fault currents.
- H. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- I. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- J. Electronic Trip Circuit Breakers: Field-replaceable rating plug, RMS sensing, with the following field-adjustable settings:
  - 1. Instantaneous trip.
  - 2. Long- and short-time pickup levels.
  - 3. Long- and short-time time adjustments.
  - 4. Ground-fault pickup level, time delay, and I-squared t response.
- K. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.
- L. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.
- M. GFLS Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6 mA trip).
- N. GFEP Circuit Breakers: With Class B ground-fault protection (30 mA trip).
- O. Features and Accessories:
  - 1. Standard frame sizes, trip ratings, and number of poles.
  - 2. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
  - 3. Lugs: Compression type, suitable for number, size, trip ratings, and conductor material.

## 2.4 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, UL 50E, and UL 50, to comply with environmental conditions at installed location.
- B. Enclosure Finish: Enclosure must be finished with gray baked enamel paint, electrodeposited on cleaned, phosphatized galvanized steel (UL 50E Types 3R, 12).



- C. Conduit Entry: UL 50E Types 4, 4X, and 12 enclosures may not contain knockouts. UL 50E Types 7 and 9 enclosures must be provided with threaded conduit openings in both endwalls.
- D. Operating Mechanism: Circuit-breaker operating handle must be directly operable through dead front trim of enclosure (UL 50E Type 3R). Cover interlock mechanism must have externally operated override. Override may not permanently disable interlock mechanism, which must return to locked position once override is released. Tool used to override cover interlock mechanism must not be required to enter enclosure in order to override interlock.
- E. Enclosures designated as UL 50E Type 4, 4X stainless steel, 12, or 12K must have dual cover interlock mechanism to prevent unintentional opening of enclosure cover when circuit breaker is ON and to prevent turning circuit breaker ON when enclosure cover is open.
- F. UL 50E Type 7/9 enclosures must be furnished with breather and drain kit to allow their use in outdoor and wet location applications.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
  - 1. Commencement of work will indicate Installer's acceptance of areas and conditions as satisfactory.

### 3.2 SELECTION OF ENCLOSURES

- A. Indoor, Dry and Clean Locations: UL 50E, Type 1.
- B. Outdoor Locations: UL 50E, Type 3R.

### 3.3 INSTALLATION

- A. Comply with manufacturer's published instructions.
- B. Special Techniques:
  - 1. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
  - 2. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
  - 3. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

4. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
5. Install fuses in fusible devices.

### 3.4 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
  1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  2. Label each enclosure with engraved metal or laminated-plastic nameplate.

### 3.5 PROTECTION

- A. After installation, protect enclosed switches and circuit breakers from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 262816