



# PROJECT MANUAL

## *CHANGE IN SCOPE RE-BID*

*Replace Emergency Generator, Infrastructure*

*St. Louis Forensic Treatment Center - South*

*St. Louis, Missouri*

Designed By: Rogers-Schmidt Engineering Co., PC.  
1736 West Park Center Dr., Suite 204  
St. Louis, MO 63026

Date Issued: October 10, 2022

Project No.: M1908-01 REBID

STATE *of* MISSOURI

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OFFICE *of* ADMINISTRATION

Facilities Management, Design & Construction

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## **SECTION 000107A - PROFESSIONAL SEALS AND CERTIFICATIONS - GENERAL & ELECTRICAL**

**PROJECT NUMBER:** M1908-01 REBID

**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:**

### **Certifications of Responsibility**

The design professional whose personal seal and signature appear hereon, assumes responsibility only for what appears on the documents listed below and disclaims, pursuant to Missouri Code of State Regulations CSR 2030-3.060, any responsibility for any and all other plans, specifications, estimates, reports or other documents or instruments not sealed by the undersigned design professional relating to, or intended to be used for any part or parts of the project to which this refers.

### **Drawings:**

G Series  
ES, ED and E Series

### **Specifications:**

Divisions 1 and 26



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Expires 12/31/22  
Barry D. Freiner, P.E.

**END OF SECTION 000107A**

**SECTION 000107B - PROFESSIONAL SEALS AND CERTIFICATIONS -  
MECHANICAL**

**PROJECT NUMBER:** M1908-01 REBID

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**Drawings:**

MS-102

**Specifications:**

Divisions 2, 9 and 23



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Expires 12/31/23

Christopher L. Barth, P.E.

**END OF SECTION 000107B**

## SECTION 000107C - PROFESSIONAL SEALS AND CERTIFICATIONS – CIVIL & STRUCTURAL

**PROJECT NUMBER:** M1908-01 REBID

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### **Certifications of Responsibility**

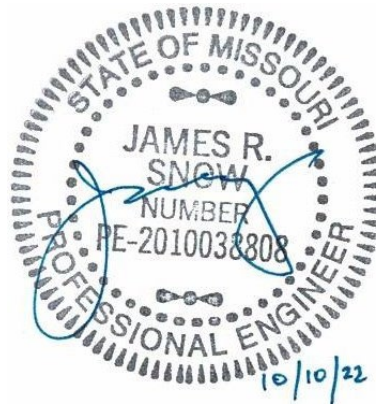
The design professional whose personal seal and signature appear hereon, assumes responsibility only for what appears on the documents listed below and disclaims, pursuant to Missouri Code of State Regulations CSR 2030-3.060, any responsibility for any and all other plans, specifications, estimates, reports or other documents or instruments not sealed by the undersigned design professional relating to, or intended to be used for any part or parts of the project to which this refers.

### **Drawings:**

S Series

### **Specifications:**

Divisions 3 and 31



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James R. Snow, P.E., S.E

**END OF SECTION 000107C**



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### 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> |
|-----|---|----------------|-------------|
| 1.  | Cover Sheet                                       | Sheet G-001    | 10-10-22    |
| 2.  | Site Maps and Drawing Index                       | Sheet G-002    | 10-10-22    |
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Change in Scope, Re-Bid: Replace Emergency Generator, Infrastructure  
St. Louis Forensic Treatment Center - South, St. Louis, Missouri

M1908-01

|     |                                      |             |          |
|-----|--------------------------------------|-------------|----------|
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**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. CHANGE IN SCOPE RE-BID  
Replace Emergency Generator, Infrastructure  
St. Louis Forensic Treatment Center - South  
St. Louis, Missouri  
**Project No.: M1908-01 REBID**

### 3.0 BIDS WILL BE RECEIVED:

- A. Until: 1:30 PM, Thursday, January 12, 2023
- B. **Only electronic bids on MissouriBUYS shall be accepted: <https://missouribuyss.mo.gov>. Bidder must be registered to bid.**

### 4.0 DESCRIPTION:

- A. Scope: The project includes replacement of the existing generator, transfer switches, and associated infrastructure at the St. Louis Forensic Treatment Center - South.
- 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: 10:00 AM, Tuesday, December 13, 2022, at St. Louis Forensic Treatment Center – South, Dome Building - 2nd floor conference room, 5300 Arsenal Street, St. Louis, MO.
- 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: Rogers-Schmidt Engineering Co., PC., Barry Freiner, (636) 600-1551, email: [bfreiner@rogers-schmidt.com](mailto:bfreiner@rogers-schmidt.com)
- B. Project Manager: Glenn Smith, (573) 751-1367, email: [Glenn.Smith@oa.mo.gov](mailto:Glenn.Smith@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://missouribuy.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.missouribuy.com/>) 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.missouribuy.com/>), 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. In awarding the contract the Owner may take into consideration the bidder's skill, facilities, capacity, experience, responsibility, previous work record, financial standing and the necessity of prompt and efficient completion of work herein described. Inability of any bidder to meet the requirements mentioned above may be cause for rejection of his bid. However, no contract will be awarded to any individual, partnership or corporation, who has had a contract with the State of Missouri declared in default within the preceding twelve months.
- 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 low 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 a 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 DIRECTORY***

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

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

Please note that you may search by MBE, WBE, or both as well as by region, location of the business by city or state, as well as by commodity or service.

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

<https://oa.mo.gov/sites/default/files/sdvelisting.pdf>

<https://vetbiz.va.gov/basic-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 Mental Health.

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:**                    **CHANGE IN SCOPE RE-BID  
Replace Emergency Generator, Infrastructure  
St. Louis Forensic Treatment Center - South  
St. Louis, Missouri**

**Project Number:**            **M1908-01**

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 **370 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:        | \$ |
| Alternate No. 1: | \$ |
| Alternate No. 2: | \$ |
| Alternate No. 3: | \$ |

**TOTAL CONTRACT AMOUNT:** (\$CONTRACT 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. Unit Prices (Section 004322)
  - iii. Proposed Contractors Form (Section 004336)
  - iv. MBE, WBE, SDVE Compliance Evaluation Form(s) (Section 004337)
  - v. MBE, WBE, SDVE Eligibility Determination Form for Joint Ventures (Section 004338)
  - vi. MBE, WBE, SDVE Good Faith Effort (GFE) Determination Form (Section 004339)
  - vii. Missouri Service Disabled Veteran Business Form (Section 004340)
  - viii. Affidavit of Work Authorization (Section 004541)
  - ix. 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

**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 |                |
| LOCATION |                    | DATE INSTALLED |

**SIGNIFICANT VARIATIONS FROM SPECIFIED PRODUCT**

|  |
|--|
|  |
|  |
|  |
|  |
|  |
|  |
|  |
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|  |

|   |      |
|---|------|
| <b>REASON FOR SUBSTITUTION</b>  |      |
|   |      |
|   |      |
|   |      |
|   |      |
|   |      |
| <b>DOES PROPOSED SUBSTITUTION AFFECT OTHER PARTS OF WORK?</b>   |      |
| <input type="checkbox"/> YES <input type="checkbox"/> NO  |      |
| IF YES, EXPLAIN _____   |      |
|   |      |
|   |      |
|   |      |
|   |      |
| <b>SUBSTITUTION REQUIRES DIMENSIONAL REVISION OR REDESIGN OF STRUCTURE OR A/E WORK</b>  |      |
| <input type="checkbox"/> YES <input type="checkbox"/> NO  |      |
| <b>BIDDER'S/CONTRACTOR'S STATEMENT OF CONFORMANCE OF PROPOSED SUBSTITUTION TO CONTRACT REQUIREMENT:</b>   |      |
| 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 |
| <b>REVIEW AND ACTION</b>  |      |
| <input type="checkbox"/> Resubmit Substitution Request with the following additional information:   |      |
|   |      |
| <input type="checkbox"/> Substitution is accepted.  |      |
| <input type="checkbox"/> Substitution is accepted with the following comments:  |      |
|   |      |
| <input type="checkbox"/> Substitution is not accepted.  |      |
| ARCHITECT/ENGINEER  | DATE |



STATE OF MISSOURI  
OFFICE OF ADMINISTRATION  
DIVISION OF FACILITIES MANAGEMENT, DESIGN AND CONSTRUCTION  
**FINAL RECEIPT OF PAYMENT AND RELEASE**

PROJECT NUMBER

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

TITLE

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<br><input 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)<br>\$                      |                                   | TOTAL CONTRACT SUM TO DATE (Same as Line Item 3. on Form A of Application for Payment)<br>\$ |  |
| THE TOTAL MBE/WBE/SDVE PARTICIPATION DOLLAR AMOUNT OF THIS PROJECT AS INDICATED IN THE ORIGINAL CONTRACT: \$ |                                   |  |  |
| SELECT<br>MBE, WBE,<br>SDVE  | TOTAL<br>AMOUNT OF<br>SUBCONTRACT | \$ AMOUNT<br>PAID-TO-DATE  | CONSULTANT/SUBCONSULTANT OR<br>CONTRACTOR/SUBCONTRACTOR/SUPPLIER<br>COMPANY NAME |
| <input type="checkbox"/> MBE<br><input type="checkbox"/> WBE<br><input type="checkbox"/> SDVE                | \$                                | \$   |  |
| <input type="checkbox"/> MBE<br><input type="checkbox"/> WBE<br><input type="checkbox"/> SDVE                | \$                                | \$   |  |
| <input type="checkbox"/> MBE<br><input type="checkbox"/> WBE<br><input type="checkbox"/> SDVE                | \$                                | \$   |  |
| <input type="checkbox"/> MBE<br><input type="checkbox"/> WBE<br><input type="checkbox"/> SDVE                | \$                                | \$   |  |
| <input type="checkbox"/> MBE<br><input type="checkbox"/> WBE<br><input type="checkbox"/> SDVE                | \$                                | \$   |  |
| <input type="checkbox"/> MBE<br><input type="checkbox"/> WBE<br><input type="checkbox"/> SDVE                | \$                                | \$   |  |

Revised 05/21



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

PROJECT NUMBER

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 EMBOSSEY OR  
BLACK INK RUBBER STAMP SEAL

STATE

COUNTY (OR CITY OF ST. LOUIS)

SUBSCRIBED AND SWORN BEFORE ME, THIS

DAY OF

YEAR

**USE RUBBER STAMP IN CLEAR AREA BELOW**

NOTARY PUBLIC SIGNATURE

MY COMMISSION  
EXPIRES

NOTARY PUBLIC NAME (TYPED OR PRINTED)

FILE: Closeout Documents

# GENERAL CONDITIONS

## INDEX

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- 1.10. Assignment of Contract
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#### 2. Owner/Designer Responsibilities

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#### 6. Bond and Insurance

#### 6.1. Bond

#### 6.2. Insurance

#### 7. Termination or Suspension of Contract

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#### 7.2. For Cause

#### 7.3. For Convenience



## 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.
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"**: Labor, material, supplies, plant and equipment required to perform and complete the service agreed to by the Contractor in a safe, expeditious, orderly and workmanlike manner so that the project shall be complete and finished 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 plate 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.
- 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,

#### **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

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 negotiated, and may vary according to the nature, extent, and complexity of the work involved. However, the overhead and profit for the Contractor or subcontractor actually performing the work shall not exceed 14%. When one or more tiers of subcontractors are used, in no event shall any Contractor or subcontractor receive as overhead and profit more than 3% of the cost of the work performed by any of his subcontractors. In no case shall the total overhead and profit paid by the Owner on any Contract Changes exceed twenty percent (20%) 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 bonding and insurance to their cost of work. This 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 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 negotiated, and may vary according to the nature, extent and complexity of the work involved, but in no case shall be less than ten percent (10%). If the percentage for overhead and profit charged for work added by Contract Changes for this contract has been negotiated to less than 10%, the negotiated rate shall then apply to credits as well.
- 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:                    | Barry Freiner<br>Rogers-Schmidt Engineering CO., PC.<br>1736 West Park Center Dr., Suite 204<br>St. Louis, MO 63026<br>Telephone: (636) 600-1551<br>Email: <a href="mailto:bfreiner@rogers-schmidt.com">bfreiner@rogers-schmidt.com</a>                     |
| Construction Representative: | Mike Howard<br>Division of Facilities Management, Design and Construction<br>119 Olympic Way<br>St. Peters, MO 63376<br>Telephone: (636) 524-8503<br>Email: <a href="mailto:Mike.Howard@oa.mo.gov">Mike.Howard@oa.mo.gov</a>                                |
| Project Manager:             | Glenn Smith<br>Division of Facilities Management, Design and Construction<br>301 West High Street, Room 730<br>Jefferson City, Missouri 65101<br>Telephone: (573) 751-1367<br>Email: <a href="mailto:Glenn.Smith@oa.mo.gov">Glenn.Smith@oa.mo.gov</a>       |
| Contract Specialist:         | Paul Girouard<br>Division of Facilities Management, Design and Construction<br>301 West High Street, Room 730<br>Jefferson City, Missouri 65102<br>Telephone: (573) 751-4797<br>Email: <a href="mailto:Paul.Girouard@oa.mo.gov">Paul.Girouard@oa.mo.gov</a> |

### **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 4 complete sets of drawings and specifications at no charge.
- B. The Owner will furnish the Contractor with approximately 4 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.

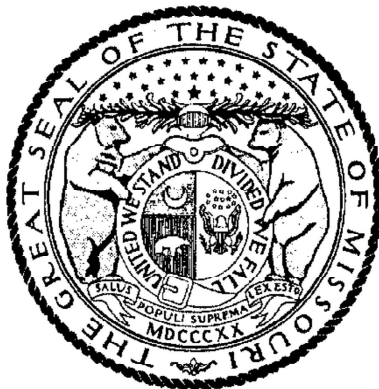
### **5.0 SAFETY REQUIREMENTS**

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. 29

Section 096  
**CITY OF ST. LOUIS CITY**

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, 2022

Last Date Objections May Be Filed: April 11, 2022

Prepared by Missouri Department of Labor and Industrial Relations

| OCCUPATIONAL TITLE           | **Prevailing<br>Hourly<br>Rate |
|------------------------------|--------------------------------|
| Asbestos Worker              | \$64.38                        |
| Boilermaker                  | \$39.40*                       |
| Bricklayer                   | \$60.67                        |
| Carpenter                    | \$59.02                        |
| Lather                       |                                |
| Linoleum Layer               |                                |
| Millwright                   |                                |
| Pile Driver                  |                                |
| Cement Mason                 | \$53.06                        |
| Plasterer                    |                                |
| Communications Technician    | \$59.99                        |
| Electrician (Inside Wireman) | \$71.98                        |
| Electrician Outside Lineman  | \$67.58                        |
| Lineman Operator             |                                |
| Lineman - Tree Trimmer       |                                |
| Groundman                    |                                |
| Groundman - Tree Trimmer     |                                |
| Elevator Constructor         | \$91.46                        |
| Glazier                      | \$64.67                        |
| Ironworker                   | \$65.52                        |
| Laborer                      | \$51.43                        |
| General Laborer              |                                |
| First Semi-Skilled           |                                |
| Second Semi-Skilled          |                                |
| Mason                        | \$39.40*                       |
| Marble Mason                 |                                |
| Marble Finisher              |                                |
| Terrazzo Worker              |                                |
| Terrazzo Finisher            |                                |
| Tile Setter                  |                                |
| Tile Finisher                |                                |
| Operating Engineer           | \$65.22                        |
| Group I                      |                                |
| Group II                     |                                |
| Group III                    |                                |
| Group III-A                  |                                |
| Group IV                     |                                |
| Group V                      |                                |
| Painter                      | \$40.84                        |
| Plumber                      | \$73.90                        |
| Pipe Fitter                  |                                |
| Roofer                       | \$55.02                        |
| Sheet Metal Worker           | \$70.01                        |
| Sprinkler Fitter             | \$76.17                        |
| Truck Driver                 | \$39.40*                       |
| 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 Section 290.210 RSMo.

Heavy Construction Rates for  
City of ST. LOUIS CITY

Section 096

| OCCUPATIONAL TITLE            | **Prevailing<br>Hourly<br>Rate |
|-------------------------------|--------------------------------|
| Carpenter                     | \$48.40                        |
| Millwright                    |                                |
| Pile Driver                   |                                |
| Electrician (Outside Lineman) | \$67.58                        |
| Lineman Operator              |                                |
| Lineman - Tree Trimmer        |                                |
| Groundman                     |                                |
| Groundman - Tree Trimmer      |                                |
| Laborer                       | \$49.07                        |
| General Laborer               |                                |
| Skilled Laborer               |                                |
| Operating Engineer            | \$65.72                        |
| Group I                       |                                |
| Group II                      |                                |
| Group III                     |                                |
| Group IV                      |                                |
| Truck Driver                  | \$39.40*                       |
| 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. 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 Section 290.210 RSMo.

# **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 01 Specification Sections apply to this Section.

#### **1.2 WORK COVERED BY CONTRACT DOCUMENTS**

- A. The Project consists of replacement of the existing generator, transfer switches and associated infrastructure at the St. Louis Forensic Treatment Center - South.
  - 1. Project Location: 5300 Arsenal Street, St. Louis, Missouri 63139.
  - 2. Owner: State of Missouri, Office of Administration, Division of Facilities Management, Design and Construction, Harry S Truman State Office Building, Post Office Box 809, 301 West High Street, Jefferson City, Missouri 65102.
- B. Contract Documents, dated October 10, 2022, were prepared for the Project by Rogers-Schmidt Engineering Co., P.C., 1736 West Park Center Dr., Suite 204, St. Louis, Missouri 63026.
- C. The Work consists of existing generator and transfer switches at the St. Louis Forensic Treatment Center - South including the associated infrastructure and building modifications.
  - 1. The Work includes, but is not limited to:
    - a. Demolition of existing 600kW diesel-engine-driven generator set, including batteries, battery charger, control panel, exhaust silencer, 50-gallon fuel oil day tank and weatherproof outdoor enclosure. Equipment to be turned over to Owner by placing on Owner furnished trailer at the project site.
    - b. Demolition of four (4) existing 480V automatic transfer switches. ATS-1 and ATS-4 to be turned over to Owner at the project site.
    - c. Demolition of existing power feeder conduit and wiring, control circuit conduit and wiring, generator remote annunciator, and branch circuit wiring.
    - d. Installation of a new 1000kW diesel-engine-driven generator set with outdoor sound attenuated weatherproof enclosure, including batteries, battery charger, output circuit breakers, control panel, exhaust silencer, 2000-gallon fuel oil belly tank, 500kW resistive load bank and generator connection cabinet. (Resistive load bank is Alternate Bid No. 2.)
    - e. Installation of new generator distribution switchboard.
    - f. Installation of nine (9) new 480V open-transition automatic transfer switches and one (1) new 480V open-transition fire pump automatic transfer switch. Nine (9) closed-transition ATSS are to provided in lieu of the nine (9) open-transition ATSS under Alternate Bid No. 1.)

- g. Preventative maintenance service on the existing outdoor 4.16 kV main switchgear and outdoor 4.16 kV automatic transfer switch. (Alternate Bid No. 3)
  - h. Protective device coordination study and arc flash risk assessment, including arc flash hazard warning labeling of all new and existing electrical equipment throughout the facility.
- D. The Work will be constructed under a single prime contract.

### **1.3 WORK SEQUENCE**

- A. The Work will be conducted under one contract.
- B. The Work shall be completed in accordance with the Construction Phasing & Scheduling indicated on Drawing G-003 – Construction Limits, Schedule & Phasing.
- C. The Contractor shall provide a work sequence plan and schedule indicating phasing of work for review and approval by the Construction Representative prior to commencing with any of the 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.
  - 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 buildings 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.
- B. Partial Owner Occupancy: The Owner reserves the right to occupy and to place and install equipment in completed areas of the building prior to Substantial Completion, provided

such occupancy does not interfere with completion of the Work. Such placing of equipment and partial occupancy shall not constitute acceptance of the total Work.

1. The Designer will prepare a Certificate of Partial Occupancy for each specific portion of the Work to be occupied prior to substantial completion.
2. Prior to partial Owner occupancy, mechanical and electrical systems shall be fully operational. Required inspections and tests shall have been successfully completed. Upon occupancy, the Owner will operate and maintain mechanical and electrical systems serving occupied portions for the building.
3. Upon occupancy, the Owner will assume responsibility for maintenance and custodial service for occupied portions for the building.

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

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

**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 01 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 Contract Change.
- B. Types of allowances include the following:
  - 1. Weather allowances.
- C. Related Sections include the following:
  - 1. Division 01 Section "Contract Modification Procedures" for procedures for submitting and handling Contract Changes for allowances.

#### **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 Contract Change time extension will be executed for “bad weather” days, as defined above, encountered during the remainder of the Project.

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

## **PART 3 - EXECUTION**

### **3.1 SCHEDULE OF ALLOWANCES**

- A. Weather Allowance: Included within the completion period for this Project ten (10) “bad weather” days.

**END OF SECTION 012100**

## **SECTION 012300 - ALTERNATES**

### **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 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes administrative and procedural requirements governing Alternates.

#### **1.3 DEFINITIONS**

- A. Definition: An alternate is an amount proposed by bidders and stated on the Bid Form for certain work defined in the Bidding Requirements that may be added to the Base Bid amount if the Owner decides to accept a corresponding change in either the amount of construction to be completed, or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
  - 1. The cost for each alternate is the net addition to the Contract Sum to incorporate the Alternate into the Work. No other adjustments are made to the Contract Sum.
- B. No additional time will be allowed for alternate work unless the number of work days is so stated on the bid form.

#### **1.4 PROCEDURES**

- A. Coordination: Modify or adjust affected adjacent Work as necessary to completely and fully integrate the Alternate Work into the Project.
  - 1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not mentioned as part of the Alternate.
- B. Notification: The award of the Contract will indicate whether alternates have been accepted or rejected.
- C. Execute accepted alternates under the same conditions as other Work of this Contract.
- D. Schedule: A "Schedule of Alternates" is included at the end of this Section. Specification Sections referenced in the Schedule contain requirements for materials necessary to achieve the Work described under each alternate.

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

### **PART 3 - EXECUTION**

#### **3.1 SCHEDULE OF ALTERNATES**

- A. Alternate No. 1: New automatic transfer switches ATS-2, ATS-3, ATS-6, ATS-7, ATS-8, ATS-9, ATS-10 and ATS-11 are to be closed transition type and ATS-4 is to be closed transition type with bypass in accordance with Specification Section 263623.13 –

Change in Scope, Re-Bid: Replace Emergency Generator, Infrastructure  
St. Louis Forensic Treatment Center - South, St. Louis, Missouri

M1908-01

Automatic Transfer Switches, Closed Transition in lieu of open transition type and open transition type with bypass in accordance with Specification Section 263623 – Automatic Transfer Switches, Open Transition.

- B. Alternate No. 2: Provide a factory installed, radiator mounted automatic resistive load bank on the diesel-engine-generator set in accordance with Specification Section 263236 – Resistive Load Bank.
- C. Alternate No. 3: Perform preventative maintenance and cleaning services on the outdoor 4.16 kV main switchgear and outdoor metal-enclosed 4.16 kV automatic transfer switchgear in accordance with Specification Section 260115 - Preventative Maintenance for 4.16kV Electrical Equipment.

**END OF SECTION 012300**

## SECTION 012500 - SUBSTITUTION PROCEDURES

### 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 administrative and procedural requirements for substitutions.
- B. Related Requirements:
  - 1. Division 00, Section 006325 "Product Substitution Request" for the required form to be completed and submitted to request approval of a product substitution.
  - 2. Division 01, Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

#### 1.3 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
  - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
  - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

#### 1.4 ACTION SUBMITTALS

- A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
  - 1. Substitution Request Form: Use Owner provided form in Section 006325 – Product Substitution Request.
  - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
    - a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
    - b. Coordination information, including a list of changes or revisions needed to other parts of the Work that will be necessary to accommodate proposed substitution.
    - c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design



characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.

- d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
  - e. Samples, where applicable or requested.
  - f. Certificates and qualification data, where applicable or requested.
  - g. List of similar installations for completed projects with project names and addresses and names and addresses of Designers and Owners.
  - h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
  - i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
  - j. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
  - k. Cost information, including a proposal of change, if any, in the Contract Sum.
  - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
  - m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
3. Designer's Action: If necessary, Designer will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Designer will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Change Order, Construction Change Directive, or Designer's Supplemental Instructions for minor changes in the Work.
  - b. Use product specified if Designer does not issue a decision on use of a proposed substitution within time allocated.

## 1.5 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

## 1.6 PROCEDURES

- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

## PART 2 - PRODUCTS

### 2.1 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.
1. Conditions: Designer will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Designer will return requests without action, except to record noncompliance with these requirements:
- a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
  - b. Substitution request is fully documented and properly submitted.
  - c. Requested substitution will not adversely affect Contractor's construction schedule.
  - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
  - e. Requested substitution is compatible with other portions of the Work.
  - f. Requested substitution has been coordinated with other portions of the Work.
  - g. Requested substitution provides specified warranty.
  - h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
- B. Substitutions for Convenience: Designer will consider requests for substitution if received within 30 days after the Notice to Proceed. Requests received after that time may be considered or rejected at discretion of Designer.
1. Conditions: Designer will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Designer will return requests without action, except to record noncompliance with these requirements:
- a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Designer for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
  - b. Requested substitution does not require extensive revisions to the Contract Documents.
  - c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
  - d. Substitution request is fully documented and properly submitted.

- e. Requested substitution will not adversely affect Contractor's construction schedule.
- f. Requested substitution has received necessary approvals of authorities having jurisdiction.
- g. Requested substitution is compatible with other portions of the Work.
- h. Requested substitution has been coordinated with other portions of the Work.
- i. Requested substitution provides specified warranty.
- j. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

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

**END OF SECTION 012500**

## **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 01 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 00, Section 007213, Article 3.1 "Acceptable Substitutions" for administrative procedures for handling Requests for Substitutions made after Contract award.
  - 2. Division 00, Section 007213, Article 4.0 "Changes in the Work" for Contract Change requirements.
  - 3. Division 01, Section 012100 "Allowances" for procedural requirements for handling and processing Allowances.
  - 4. Division 01, Section 013115 "Project Management Communications" for use of the Internet web-based project management communications tool, E-Builder® ASP software.

#### **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 Contract Change 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's Construction 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's Construction 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 Contract Change Detailed Breakdown form. Subcontractors may use the appropriate Contract Change 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 CONTRACT CHANGE PROCEDURES**

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

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

### **PART 3 - EXECUTION**

#### **3.1 REFERENCED FORMS**

- A. The following forms can be found on our website at <https://oa.mo.gov/facilities/vendor-links/architectengineering-forms> or <https://oa.mo.gov/facilities/vendor-links/contractor-forms>:
  - 1. Request for Information
  - 2. Designer's Supplemental Instructions

3. Request for Proposal
4. Contract Change
5. Contract Change Detailed Breakdown – SAMPLES
6. Contract Change Detailed Breakdown – General Contractor (GC)
7. Contract Change Detailed Breakdown – Subcontractor (SUB)

**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 01 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. Articles 1.8.B and 1.8.C of Section 007213 "General Conditions" for coordinating meetings onsite.
  - 2. Article 5.4.H of Section 007213 "General Conditions" for coordinating Closeout of the Contract.
  - 3. Division 01, Section 013115 "Project Management Communications" for use of the Internet web-based project management communications tool, E-Builder® ASP software.
  - 4. Division 01, Section 013200 "Schedule – Bar Chart" for preparing and submitting Contractor's Construction Schedule.

#### **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) workdays 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 Contract Changes
    - 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 and number
  - 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 Applicable)**

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

**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 01 Specification Sections, apply to this Section.
- B. Division 01, Section 012600 – Contract Modification Procedures
- C. Division 01, Section 013300 – Submittals

#### **1.2 SUMMARY**

- A. Project Management Communications: The Contractor shall use the Internet web-based project management communications tool, E-Builder® 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® as provided by "E-Builder®" 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® 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® 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.
  - 1. 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.
  - 2. 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.

3. 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 user's 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)**

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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.

**END OF SECTION 013115**

Change in Scope, Re-Bid: Replace Emergency Generator, Infrastructure  
St. Louis Forensic Treatment Center - South, St. Louis, Missouri

M1908-01

PROJECT MANAGEMENT COMMUNICATIONS  
03/20 (EB)

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## **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 and Division 01 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) \$1,000,000.00 (One million) and under – 2% of the total contract amount
      - 2) Over \$1,000,000.00 (One million) – 1% of the total contract amount
    - b. Close Out Documents
      - 1) \$1,000,000.00 (One million) and under – 2% of the total contract amount
      - 2) 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, Designer, 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 01 Specification Sections apply to this Section.
- B. Division 01, Section 013115 “Project Management Communications” for use of the Internet web-based project management communications tool, E-Builder® ASP software.

#### **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 01 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 Division 00, Section 007213 “General Conditions”, Article 3.2 “Submittals”.
- 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 24"x36".

## **1.5 PRODUCT DATA**

- A. The Contractor shall comply with Division 00, Section 007213 "General Conditions", Article 3.2 "Submittals".
- 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 Division 00, Section 007213 "General Conditions", Article 3.2 "Submittals".
- 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 Division 00, Section 007213 "General Conditions", Article 3.2 "Submittals".
- 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 two (2) sets of prints, black and white, glossy; 8"x10" size; mounted on 8½"x11" soft card stock with left edge binding margin for 3-hole punch.
  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 Division 00, Section 007213 "General Conditions", Article 3.5 "Operation and Maintenance Manuals", and Division 00, Section 007300 "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.

## **END OF SECTION 013300**



## SECTION 013300.10 - SUBMITTAL REGISTER

| SPEC SECTION | TITLE   | CATEGORY                       |
|--------------|---|--------------------------------|
| 012500       | Substitution Requests   | Product Data                   |
| 013100       | Coordination - Coordination Drawings  | Shop Drawings                  |
| 013100       | Coordination - Key Personnel Names  | List of Subcontractors         |
| 013200       | Schedules - Bar Chart   | Construction Schedule          |
| 013200       | Schedules - Bar Chart   | Schedule of Values             |
| 013200       | Schedules - Bar Chart - Schedule of Inspections and Tests                           | Construction Schedule          |
| 013200       | Schedules - Bar Chart   | Major Material Suppliers       |
| 013300       | Submittals - Record Drawings  | As-Builts                      |
| 013300       | Submittals - Notifications & Permits  | Certification                  |
| 013300       | Submittals - Quality Control  | Certification                  |
| 013300       | Submittals  | Certification                  |
| 013300       | Submittals - Inspection & Test Reports  | Certification                  |
| 013300       | Submittals - Construction Photographs   | Certification                  |
| 013300       | Submittals - O&M Manuals  | Operation / Maintenance Manual |
| 013513.19    | Site Security and Health Requirements (DMH) - MSDS                                  | Product Data                   |
| 013513.19    | Site Security and Health Requirements (DMH) - Schedule of Proposed Shutdowns        | Construction Schedule          |
| 013513.19    | Site Security and Health Requirements (DMH) - Employee List for Security Clearances | Certification                  |
| 015000       | Construction Facilities and Temporary Controls - Temporary Utilities                | Test Report                    |
| 015000       | Construction Facilities and Temporary Controls - Temporary Utilities Schedule       | Construction Schedule          |
| 016000       | Product Requirements - Comparable Product Requests                                  | Product Data                   |
| 017823       | Operation and Maintenance Manual Data   | Operation / Maintenance Manual |
| 024119       | Selective Demolition  | Construction Schedule          |
| 024119       | Selective Demolition - Predemolition Photos   | Certification                  |
| 024119       | Selective Demolition - Landfill Records   | Certification                  |
| 031000       | Concrete Forming and Accessories  | Product Data                   |
| 031000       | Concrete Forming and Accessories  | Shop Drawings                  |
| 032000       | Concrete Reinforcement  | Shop Drawings                  |
| 032000       | Concrete Reinforcement  | Product Data                   |
| 032000       | Concrete Reinforcement  | Certification                  |
| 033000       | Cast-in-Place Concrete  | Product Data                   |
| 033000       | Cast-in-Place Concrete  | Shop Drawings                  |
| 033000       | Cast-in-Place Concrete  | Certification                  |
| 033000       | Cast-in-Place Concrete  | As-Builts                      |
| 033000       | Cast-in-Place Concrete  | Test Report                    |
| 099100       | Painting  | Product Data                   |
| 099100       | Painting  | Sample                         |

| SPEC SECTION | TITLE  | CATEGORY                       |
|--------------|--|--------------------------------|
| 099100       | Painting   | Certification                  |
| 099100       | Painting   | Test Report                    |
| 230505       | Selective Demolition for HVAC  | Construction Schedule          |
| 230505       | Selective Demolition for HVAC  | Test Report                    |
| 230523       | General Duty Valves for HVAC Piping  | Product Data                   |
| 230523       | General Duty Valves for HVAC Piping  | Certification                  |
| 230523       | General Duty Valves for HVAC Piping  | Test Report                    |
| 230523       | General Duty Valves for HVAC Piping  | Operation / Maintenance Manual |
| 230529       | Hangers and Supports for HVAC Piping and Equipment   | Product Data                   |
| 230529       | Hangers and Supports for HVAC Piping and Equipment   | Shop Drawings                  |
| 230553       | Identification for HVAC Piping and Equipment   | Product Data                   |
| 230553       | Identification for HVAC Piping and Equipment   | Sample                         |
| 232000       | Piping for HVAC  | Product Data                   |
| 232000       | Piping for HVAC  | Certification                  |
| 232000       | Piping for HVAC  | Test Report                    |
| 232116       | Piping Specialties   | Product Data                   |
| 232116       | Piping Specialties   | Shop Drawings                  |
| 232116       | Piping Specialties   | Test Report                    |
| 232116       | Piping Specialties   | Operation / Maintenance Manual |
| 232116       | Piping Specialties   | Warranty                       |
| 260115       | Preventative Maintenance for 4.16kV Electrical Equipment (Alternate Bid No. 3)   | Certification                  |
| 260115       | Preventative Maintenance for 4.16kV Electrical Equipment (Alternate Bid No. 3)   | Test Report                    |
| 260505       | Selective Demolition for Electrical - Schedule of Selective Demolition Activities  | Construction Schedule          |
| 260505       | Selective Demolition for Electrical - Inventory of Items to be Salvaged  | Shop Drawings                  |
| 260505       | Selective Demolition for Electrical - Predemolition Photographs or Video   | Shop Drawings                  |
| 260505       | Selective Demolition for Electrical - Disposal Records   | Certification                  |
| 260513       | Medium-Voltage Cables  | Product Data                   |
| 260513       | Medium-Voltage Cables  | Certification                  |
| 260513       | Medium-Voltage Cables  | Test Report                    |
| 260519       | Low-Voltage Electrical Power Conductors and Cables - 600-volt Building Wire  | Product Data                   |
| 260519       | Low-Voltage Electrical Power Conductors and Cables - 600-volt mineral-insulated power cable and accessories                | Product Data                   |
| 260519       | Low-Voltage Electrical Power Conductors and Cables - 600-volt Multiconductor Control Cable                                 | Product Data                   |
| 260519       | Low-Voltage Electrical Power Conductors and Cables 600-volt mineral-insulated multiconductor control cable and accessories | Product Data                   |
| 260519       | Low-Voltage Electrical Power Conductors and Cables - 600-volt Shielded Instrumentation Cable                               | Product Data                   |

| SPEC SECTION | TITLE  | CATEGORY      |
|--------------|--|---------------|
| 260519       | Low-Voltage Electrical Power Conductors and Cables - CAT 6 Copper Ethernet Cable                 | Product Data  |
| 260519       | Low-Voltage Electrical Power Conductors and Cables - Test Reports                                | Test Report   |
| 260526       | Grounding and Bonding for Electrical Systems - Grounding Conductors                              | Product Data  |
| 260526       | Grounding and Bonding for Electrical Systems - Exothermic Welds                                  | Product Data  |
| 260526       | Grounding and Bonding for Electrical Systems - Grounding Clamps                                  | Product Data  |
| 260526       | Grounding and Bonding for Electrical Systems - Grounding Connectors                              | Product Data  |
| 260526       | Grounding and Bonding for Electrical Systems - Grounding Lugs                                    | Product Data  |
| 260526       | Grounding and Bonding for Electrical Systems - Grounding Rods                                    | Product Data  |
| 260526       | Grounding and Bonding for Electrical Systems - Grounding Rod Resistance Test Report              | Test Report   |
| 260529       | Hangers and Supports for Electrical Equipment - Expansion Anchors                                | Product Data  |
| 260529       | Hangers and Supports for Electrical Equipment - U-Channel Supports & Accessories                 | Product Data  |
| 260529       | Hangers and Supports for Electrical Equipment - Seismic Restraints                               | Product Data  |
| 260533.13    | Conduit for Electrical Systems - Each Type of Conduit  | Product Data  |
| 260533.13    | Conduit for Electrical Systems - Conduit Hubs  | Product Data  |
| 260533.13    | Conduit for Electrical Systems - Conduit Expansion Fittings                                      | Product Data  |
| 260533.13    | Conduit for Electrical Systems - Internal Conduit Sealing Bushings                               | Product Data  |
| 260533.13    | Conduit for Electrical Systems - External Conduit Sealing Bushings or Link Seals                 | Product Data  |
| 260533.13    | Conduit for Electrical Systems - Conduit Penetration Sealing Assemblies                          | Product Data  |
| 260533.13    | Conduit for Electrical Systems - Conduit Bodies  | Product Data  |
| 260533.13    | Conduit for Electrical Systems - Conduit Mounting Clamps   | Product Data  |
| 260533.13    | Conduit for Electrical Systems - Fire-Stopping Materials   | Product Data  |
| 260533.13    | Conduit for Electrical Systems - Intumescent Silicone Sealant                                    | Product Data  |
| 260533.13    | Conduit for Electrical Systems - Protective Coating for Underground Conduit                      | Product Data  |
| 260533.13    | Conduit for Electrical Systems - Underground Warning Tape  | Product Data  |
| 260533.13    | Conduit for Electrical Systems - Conduit/Duct Plugs  | Product Data  |
| 260533.13    | Conduit for Electrical Systems - Conduit Spacers for Underground Conduit Duct Banks              | Product Data  |
| 260533.13    | Conduit for Electrical Systems - Red Cement Coloring Dye for Concrete Encased Conduit Duct Banks | Product Data  |
| 260533.16    | Boxes for Electrical Systems - Outlet and Non-Dimensioned Junction and Pull Boxes                | Product Data  |
| 260533.16    | Boxes for Electrical Systems - Device Boxes  | Product Data  |
| 260533.16    | Boxes for Electrical Systems - Dimensioned Junction and Pull Boxes                               | Product Data  |
| 260553       | Identification for Electrical Systems - Nameplate Type   | Product Data  |
| 260553       | Identification for Electrical Systems - Nameplate Engraving Schedule                             | Shop Drawings |
| 260553       | Identification for Electrical Systems - Wire and Cable Identification Label                      | Product Data  |
| 260553       | Identification for Electrical Systems - Medium-Voltage Power Circuit Identification Tags         | Product Data  |
| 260553       | Identification for Electrical Systems - Conduit Marker   | Product Data  |

| SPEC SECTION | TITLE   | CATEGORY                       |
|--------------|---|--------------------------------|
| 260553       | Identification for Electrical Systems - Arc Flash Hazard Warning Labels                             | Product Data                   |
| 260573       | Protective Device Coordination Study & Arc Flash Risk Assessment - Software IEEE 399 Compliance     | Certification                  |
| 260573       | Protective Device Coordination Study & Arc Flash Risk Assessment - Study Specialist Qualifications  | Certification                  |
| 260573       | Protective Device Coordination Study & Arc Flash Risk Assessment - References for Arc Flash Studies | Certification                  |
| 260573       | Protective Device Coordination Study & Arc Flash Risk Assessment - Demonstrate of Capabilities      | Certification                  |
| 260573       | Protective Device Coordination Study & Arc Flash Risk Assessment - Equipment Label Qualifications   | Certification                  |
| 260573       | Protective Device Coordination Study & Arc Flash Risk Assessment - Single-Line Diagram              | Shop Drawings                  |
| 260573       | Protective Device Coordination Study & Arc Flash Risk Assessment - Fault Current Study Report       | Shop Drawings                  |
| 260573       | Protective Device Coordination Study & Arc Flash Risk Assessment - Coordination Study Report        | Shop Drawings                  |
| 260573       | Protective Device Coordination Study & Arc Flash Risk Assessment - Equipment Evaluation Report      | Shop Drawings                  |
| 260573       | Protective Device Coordination Study & Arc Flash Risk Assessment - OCPD Settings Report             | Shop Drawings                  |
| 260573       | Protective Device Coordination Study & Arc Flash Risk Assessment - Arc Flash Risk Assessment Report | Shop Drawings                  |
| 260573       | Protective Device Coordination Study & Arc Flash Risk Assessment - Final Report                     | Shop Drawings                  |
| 260583       | Wiring Connections - 600-Volt Connectors  | Product Data                   |
| 260583       | Wiring Connections - 600-Volt Terminations  | Product Data                   |
| 260583       | Wiring Connections - CAT 6 Copper Ethernet Connectors   | Product Data                   |
| 262413       | Switchboards  | Product Data                   |
| 262413       | Switchboards  | Shop Drawings                  |
| 262413       | Switchboards  | Certification                  |
| 262413       | Switchboards  | Test Report                    |
| 262413       | Switchboards  | Warranty                       |
| 262413       | Switchboards  | Operation / Maintenance Manual |
| 262416       | Panelboards   | Product Data                   |
| 262416       | Panelboards   | Shop Drawings                  |
| 262416       | Panelboards   | Certification                  |
| 262416       | Panelboards   | Test Report                    |
| 262416       | Panelboards   | Warranty                       |
| 262416       | Panelboards   | Operation / Maintenance Manual |
| 262726       | Wiring Devices  | Product Data                   |
| 262813       | Fuses - Each Type of Fuse   | Product Data                   |
| 262816.13    | Enclosed Circuit Breakers   | Product Data                   |

| SPEC SECTION | TITLE  | CATEGORY                       |
|--------------|--|--------------------------------|
| 262816.13    | Enclosed Circuit Breakers  | Shop Drawings                  |
| 262912       | Motor Control  | Product Data                   |
| 263213.13    | Diesel-Engine-Driven Generator Set                                   | Product Data                   |
| 263213.13    | Diesel-Engine-Driven Generator Set                                   | Shop Drawings                  |
| 263213.13    | Diesel-Engine-Driven Generator Set                                   | Certification                  |
| 263213.13    | Diesel-Engine-Driven Generator Set                                   | Test Report                    |
| 263213.13    | Diesel-Engine-Driven Generator Set                                   | Warranty                       |
| 263213.13    | Diesel-Engine-Driven Generator Set                                   | Operation / Maintenance Manual |
| 263236       | Resistive Load Bank (Alternate Bid No. 2)                            | Product Data                   |
| 263236       | Resistive Load Bank (Alternate Bid No. 2)                            | Shop Drawings                  |
| 263236       | Resistive Load Bank (Alternate Bid No. 2)                            | Warranty                       |
| 263290       | Generator Connection Cabinet   | Product Data                   |
| 263290       | Generator Connection Cabinet   | Shop Drawings                  |
| 263290       | Generator Connection Cabinet   | Certification                  |
| 263290       | Generator Connection Cabinet   | Warranty                       |
| 263290       | Generator Connection Cabinet   | Operation / Maintenance Manual |
| 263623       | Automatic Transfer Switches, Open Transition                         | Product Data                   |
| 263623       | Automatic Transfer Switches, Open Transition                         | Shop Drawings                  |
| 263623       | Automatic Transfer Switches, Open Transition                         | Certification                  |
| 263623       | Automatic Transfer Switches, Open Transition                         | Test Report                    |
| 263623       | Automatic Transfer Switches, Open Transition                         | Warranty                       |
| 263623       | Automatic Transfer Switches, Open Transition                         | Operation / Maintenance Manual |
| 263623.13    | Automatic Transfer Switches, Closed Transition (Alternate Bid No. 1) | Product Data                   |
| 263623.13    | Automatic Transfer Switches, Closed Transition (Alternate Bid No. 1) | Shop Drawings                  |
| 263623.13    | Automatic Transfer Switches, Closed Transition (Alternate Bid No. 1) | Certification                  |
| 263623.13    | Automatic Transfer Switches, Closed Transition (Alternate Bid No. 1) | Test Report                    |
| 263623.13    | Automatic Transfer Switches, Closed Transition (Alternate Bid No. 1) | Warranty                       |
| 263623.13    | Automatic Transfer Switches, Closed Transition (Alternate Bid No. 1) | Operation / Maintenance Manual |
| 263623.16    | Automatic Transfer Switch for Fire Pump                              | Product Data                   |
| 263623.16    | Automatic Transfer Switch for Fire Pump                              | Shop Drawings                  |
| 263623.16    | Automatic Transfer Switch for Fire Pump                              | Certification                  |
| 263623.16    | Automatic Transfer Switch for Fire Pump                              | Test Report                    |
| 263623.16    | Automatic Transfer Switch for Fire Pump                              | Warranty                       |
| 263623.16    | Automatic Transfer Switch for Fire Pump                              | Operation / Maintenance Manual |
| 311000       | Site Clearing  | As-Builts                      |
| 312000       | Earth Moving   | Product Data                   |

| SPEC SECTION | TITLE        | CATEGORY                 |
|--------------|--------------|--------------------------|
| 312000       | Earth Moving | Test Report              |
| 312000       | Earth Moving | Major Material Suppliers |

## **SECTION 013513.19 – SITE SECURITY AND HEALTH REQUIREMENTS (DMH)**

### **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 01 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 RULES OF THE FACILITY**

- A. All workers and supervisors employed by the Contractor or any Subcontractors shall be made aware that the buildings and grounds are part of a Department of Mental Health facility and that:
  - 1. The residents/patients are to be treated with dignity.
  - 2. All work performed in/at DMH facilities is to be completed in strict compliance with HIPPA regulations. Resident/patient privacy and confidentiality shall be

maintained at all times. Photographic or audio recording of any nature and any discussion/disclosure regarding residents/patients is strictly prohibited.

3. Construction activities shall not interfere with normal facility operation, except as otherwise arranged with and approved by the Facility Representative.
4. Access to the Facility by emergency responders shall not be compromised at any time.
5. Smoking is not permitted in State-operated buildings. Smoking on grounds shall be in accordance with Facility regulations and only as approved by Facility Management.
6. Explosives or firearms and other weapons shall not be allowed onsite.
7. Keys shall not be left in unattended vehicles. Vehicles shall be locked when not in use.

B. Because of the persistent risk that residents/patients may cause harm to themselves or others, extreme caution and special care must be taken in the interest of safety.

1. Materials, tools, equipment and other construction apparatus, including, but not limited to, ropes, ladders, and flammable liquids, shall not be left unattended during working hours, and shall be securely stored during non-working hours. Secure storage includes lockable cabinets, rooms, trailers, and rigid fenced areas. The Construction Representative and the Facility Representative shall approve the location and use of exterior storage areas prior to their use.
2. The Contractor shall submit an inventory of tools, equipment, and materials to the Construction Representative in advance.
3. The Contractor shall report any missing tools, equipment, or material to the Construction Representative and Facility Representative. Unattended or unsecured tools, equipment, or material that poses a potential risk may be confiscated by Facility staff and returned only after completion of the appropriate request documents by the Contractor.
4. Access to construction areas must be controlled at all times. Appropriate barriers must be erected to secure trenches, pits, wiring, etc.
5. Construction debris and trash must be securely stored in approved containers or removed from the site at least daily.

C. If the safety of residents/patients or staff is jeopardized because safety guidelines are not properly observed, the Facility Representative will notify the Construction Representative, who may stop the Work until the situation is resolved. In such case, the Work will resume only after the unsafe conditions have been corrected, and the Contractor is notified by the Construction Representative to resume the Work.

### **3.3 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. The Contractor's workers shall not be under the influence of any intoxicating substances while on the Facility premises.

### **3.4 SECURITY CLEARANCES AND RESTRICTIONS**

- A. **FMDC REQUIRED FINGERPRINTING FOR CRIMINAL BACKGROUND AND WARRANTS CHECK**
  1. All employees of the Contractor are required to submit fingerprints to the Missouri State Highway Patrol to enable the Office of Administration, Division of Facilities Management, Design and Construction (FMDC) to receive state and national criminal background checks on such employees. FMDC reserves the right to prohibit any employee of the Contractor from performing work in or on the premises of any facility owned, operated, or utilized by the State of Missouri for any reason.
  2. The Contractor shall ensure all of its employees submit fingerprints to the Missouri State Highway Patrol and pay for the cost of such background checks. The Contractor shall submit to FMDC via email to [FMDCSecurity@oa.mo.gov](mailto:FMDCSecurity@oa.mo.gov) a list of the names of the Contractor's employees who will be fingerprinted and a signed Missouri Applicant Fingerprint Privacy Notice, Applicant Privacy Rights and Privacy Act Statement for each employee. All employees of the Contractor approved by FMDC to work at a State facility must obtain a contractor ID badge from FMDC prior to beginning work on-site, unless the Director of FMDC, at the Director's discretion, waives the requirement for a contractor ID badge. The

Contractor and its employees must comply with the process for background checks and contractor ID badges found on FMDC's website at: <https://oa.mo.gov/fmdc-contractor-id-badges>.

3. Pursuant to section 43.540, RSMo, FMDC participates in the Missouri Rap Back and National Rap Back programs as of August 28, 2018. This means that the Missouri State Highway Patrol, Central Records Repository, and the Federal Bureau of Investigation will retain the fingerprints submitted by each of the Contractor's employees, and those fingerprints will be searched against other fingerprints on file, including latent fingerprints. While retained, an employee's fingerprints may continue to be compared against other fingerprints submitted or retained by the Federal Bureau of Investigation, including latent fingerprints.
4. As part of the Missouri and National Rap Back programs, FMDC will receive notification if a new arrest is reported for an employee whose fingerprints have been submitted for FMDC after August 28, 2018. If the employee is performing work on a State contract at the time of the arrest notification, FMDC will request and receive the employee's updated criminal history records. If the employee is no longer performing work on a State contract, FMDC will not obtain updated criminal records.
5. Pursuant to section 43.540, RSMo, the Missouri State Highway Patrol will provide the results of the employee's background check directly to FMDC. FMDC may NOT release the results of a background check to the Contractor or provide the Contractor any information obtained from a background check, either verbally or in writing. FMDC will notify the Contractor only whether an employee is approved to work on State property.
6. Each employee who submits fingerprints to the Missouri State Highway Patrol has a right to obtain a copy of the results of his or her background check. The employee may challenge the accuracy and completeness of the information contained in a background check report and obtain a determination from the Missouri State Highway Patrol and/or the FBI regarding the validity of such challenge prior to FMDC making a final decision about his or her eligibility to perform work under a State contract.
7. The Contractor shall notify FMDC via email to [FMDCSecurity@oa.mo.gov](mailto:FMDCSecurity@oa.mo.gov) if an employee is terminated or resigns from employment with the Contractor. If the Contractor does not anticipate performing work on a State contract in the future, the Contractor may request that FMDC remove its employees from the Rap Back programs. However, if removed from the Rap Back programs, employees will be required to submit new fingerprints should the contractor be awarded another State contract.
8. Upon award of a Contract, the Contractor should contact FMDC at [FMDCSecurity@oa.mo.gov](mailto:FMDCSecurity@oa.mo.gov) to determine if its employees need to provide a new background check. If a Contractor's employee has previously submitted a fingerprint background check to FMDC as part of the Missouri and National Rap Back programs, the employee may not need to submit another fingerprint search for a period of three to six years, depending upon the circumstances. The Contractor understands and agrees that FMDC may require more frequent background checks without providing any explanation to the Contractor. The fact that an additional background check is requested by FMDC does not indicate that the employee has a criminal record.

### **3.5 SPECIFICATION OF REQUIRED INFECTION CONTROL PRECAUTIONS BY CLASS**

- A. This Section includes requirements for infection control in environments that residents/patients are housed in, dine in, or participate in program activities in or adjacent to the work area.
- B. The Contractor shall have the applicable measures specified below in-place any time demolition or construction activities occur in occupied or non-occupied work areas.
- C. The Contractor shall complete all specified cleaning procedures and receive clearance from the Construction Representative prior to removing any barriers and other precautionary measures – even for areas that the residents/patients do not occupy during construction.
- D. Class I – Inspection/minor maintenance activities
  - 1. Class I work includes, but is not limited to, removal of ceiling tiles for visual inspection, painting (but not sanding), wall covering, electrical trim work, minor plumbing and activities that do not generate dust or require cutting of walls or access to ceilings other than for visual inspection.
  - 2. For all Class I work, the Contractor shall employ the following precautionary measures during the project:
    - a) Perform work using methods appropriate to the work to minimize dust.
    - b) Immediately replace any ceiling tile displaced for visual inspection.
- E. Class II – Small-scale, short duration activities that create minimal dust
  - 1. Class II work includes, but is not limited to, installation of telephone and computer cables, access to chase spaces, cutting of walls or ceilings where dust migration can be easily controlled.
  - 2. For all Class II work, the Contractor shall employ the following precautionary measures during the project:
    - a) Provide at least two (2), fully charged, ten pound (10#), ABC fire extinguishers in the work area for the duration of the project.
    - b) Shut down or isolate the HVAC system in the area where the work is being performed.
    - c) Seal unused doors with duct tape.
    - d) Place “sticky mat” at entrance and exit of work area.
    - e) Provide active means to prevent airborne dust from dispersing into the atmosphere.
    - f) Water-mist work surfaces while cutting to control dust.
    - g) Wet mop and /or vacuum with HEPA-filtered vacuum before leaving the work area.
    - h) Securely contain construction waste before transport in tightly covered containers.
- F. Class II B – Low Risk, Additional Precautions:

1. Plastic barrier is to be placed during gypsum board cutting in all areas. Barriers shall extend from floor to ceiling and must be taped to the floor. In Reception area, barrier shall have a walk way developed for staff to be able to leave the area without disturbing the barrier.
  2. C123: When running cables/conduits, the hallway shall be cleared of all employees. Doors to supply areas are to remain closed. Floor cleaning machines must be removed to make access for cable/conduit drilling. Walk-off mats shall be used at entrance of supply area and electrical panel room.
- G. Class III – Work that generates a moderate to high level of dust or requires demolition or removal of any fixed building components
1. Class III work includes, but not limited to, sanding walls for painting or wall coverings, removing any floor coverings, ceiling tiles and casework; new wall construction, minor ductwork, or electrical work above ceiling; major cabling activities and any activity that cannot be completed within a single work shift.
  2. For all Class III work, the Contractor shall employ the following precautionary measures during the project:
    - a) Provide at least two (2), fully charged, ten pound (10#), ABC fire extinguishers in the work area for the duration of the project.
    - b) Shut down or isolate the HVAC system in the area where the work is being performed to prevent contamination of the duct system.
    - c) Complete all critical barriers BEFORE construction begins, and maintain for duration of the work.
    - d) Maintain negative air pressure within the worksite.
    - e) Upon completion of the work vacuum the work area with HEPA filtered vacuums.
    - f) Wipe down all hard surfaces and wet mop with disinfectant.
    - g) Remove barrier materials from the work area carefully to minimize spreading dirt and debris associated with construction. Remove barriers ONLY AFTER the complete project has been thoroughly cleaned.
    - h) Securely contain construction waste before transport in tightly covered containers.
- H. Class IV – Activities involving heavy demolition and construction
1. Class IV work includes, but not limited to, heavy demolition or removal of a complete ceiling system, and any new construction, etc., and activities that require consecutive work shifts.
  2. For all Class IV work, the Contractor shall employ the following precautionary measures during the project:
    - a) Provide at least two (2), fully charged, ten pound (10#), ABC fire extinguishers in the work area for the duration of the project.
    - b) Shut down or isolate the HVAC system in area where the work is being performed to prevent contamination of duct system.
    - c) Complete all critical barriers BEFORE construction begins, and maintain for duration of the work.

- d) Seal holes, pipes, conduits, and punctures appropriately.
- e) Maintain negative air pressure within the worksite.
- f) Construct an anteroom and require all personnel to pass through this room so they can be vacuumed using a HEPA vacuum before leaving the worksite; OR they can wear cloth or paper coveralls that are removed each time they leave the worksite.
- g) All personnel entering the worksite are required to wear shoe covers.
- h) Upon completion of the work vacuum the work area with HEPA filtered vacuums.
- i) Wipe down all hard surfaces and wet mop with disinfectant.
- j) Remove barrier materials from the work area carefully to minimize spreading dirt and debris associated with construction. Remove barriers ONLY AFTER the complete project has been thoroughly cleaned.
- k) Securely contain construction waste before transport in tightly covered containers.

### **3.6 DISRUPTION OF UTILITIES**

- A. The Contractor shall give a minimum of 72 hours written notice to the Construction Representative and Facility Representative before disconnecting electric, gas, water, fire protection, or sewer service to any building.
- B. The contractor shall give a minimum of 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 013513.19**

## SECTION 014000 - QUALITY REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 CONTRACTOR QUALITY CONTROL

- A. Contractor Quality Control: The Contractor is responsible for the overall quality of all its own work and the work performed by their subcontractors working under this contract. The quality of any part of the work installed must not be less than that required by the technical divisions of this specification. If the COR determines that the quality of work does not conform to the applicable specifications and drawings, the Contractor will be advised in writing of the areas of nonconformance, and within 7 days the Contractor must correct the deficiencies and advise the COR in writing of the corrective action taken.
- B. Noncompliance with Quality Control Requirements: Failure of the Contractor to comply with the above requirements may be cause for termination for default as defined in the terms and conditions of the contract provisions and clauses, including those concerning, *Termination for Convenience or Default*, of the general contract clauses.

#### 1.2 SUBMITTALS

- A. Prior to the start of on-site work, the Contractor must submit to the Owner's Representative a Contractor Quality Control Plan that includes the following information:
  - 1. Quality Control Organization: In chart form, showing relationship of Quality Control organization to other elements of Contractor's organization.
  - 2. Names and qualifications of personnel in Quality Control organization, including Contractor Quality Control Representative, inspectors, Independent Testing and Inspection Laboratory, and Independent HVAC Test and Balance Agency.
  - 3. Procedures for reviewing coordination drawings, shop drawings, certificates, certifications, or other submittals.
  - 4. Testing and inspection schedule, keyed to Construction Schedule, indicating tests and inspections to be performed, names of persons responsible for inspection and testing for each segment of work including preparatory, initial, and follow-up.
  - 5. Proposed forms to be used including Contractor's Daily Report, Contractor Test and Inspection Report and Non-Compliance Check-Off List.
- B. INDEPENDENT TESTING AND INSPECTION LABORATORY: Submit the following.
  - 1. Name.
  - 2. Address.
  - 3. Telephone number.
  - 4. Names of full-time registered engineer.
  - 5. Responsible officer.
  - 6. Copy of report of laboratory facilities inspection made by Materials Reference Laboratory of National Bureau of Standards during most recent inspection, with memorandum of remedies of any deficiencies reported by inspection.

### **1.3 QUALITY CONTROL PROCEDURES**

- A. Monitor quality control over Contractor staff, subcontractors, suppliers, manufacturers, products, services, site conditions, and workmanship.
- B. Comply fully with manufacturer's published instructions, including each step-in sequence of installation.
- C. Should manufacturer's published instructions conflict with Contract Documents, request clarification from Owner's Representative before proceeding.
- D. Comply with specified standards as a minimum quality for work, except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Perform work by persons who are thoroughly qualified and trained in their respective trade, to produce workmanship of specified quality.
- F. Perform tests required by governing authorities having jurisdiction and utilities having jurisdiction.

### **1.4 TESTING AND INSPECTION LABORATORY SERVICES**

- A. Selection and Payment:
  - 1. The Contractor shall pay for services of an Independent Testing and Inspection Laboratory to perform specified testing and inspection.
  - 2. Employment of Independent Testing and Inspection Laboratory in no way relieves Contractor of obligation to perform work in accordance with requirements of Contract Documents.
- B. Quality Assurance:
  - 1. Comply with requirements of all applicable ASTM standards.
  - 2. Laboratory: Authorized to operate in State in which Project is located.
  - 3. Laboratory Staff: Maintain a full-time registered engineer on staff to review services.
  - 4. Testing Equipment: Calibrated at reasonable intervals with devices of and accuracy traceable to either National Bureau of Standards or accepted values of natural physical constraints.
- C. Laboratory Responsibilities. Contractor shall ensure the Laboratory has the following responsibilities and limits on authority:
  - 1. Test samples of mixes submitted by Contractor.
  - 2. Provide qualified personnel at Project site. Cooperate with Owner's Representative and Contractor in performance of services.
  - 3. Perform specified sampling, testing, and inspection of Products in accordance with specified standards.
  - 4. Determine compliance of materials and mixes with requirements of Contract Documents.

5. Promptly notify Contractor Quality Control Representative and Owner's Representative of observed irregularities or non-conformance of work or Products.
  6. Submit one copy of all test results directly to the Owner's Representative.
  7. Perform additional tests as required by Owner's Representative.
  8. Attend appropriate preconstruction meetings and progress meetings.
- D. Limits on Authority. Contractor shall ensure the Laboratory has the following limits on authority:
1. Laboratory may not release, revoke, alter, or expand on requirements of Contract Documents.
  2. Laboratory may not approve or accept any portion of work.
  3. Laboratory may not assume any duties of Contractors.
  4. Laboratory has no authority to stop work.

## **1.5 CONTRACTOR FIELD INSPECTION AND TESTING**

- A. Contractor: Test and Inspect work provided under this Contract to ensure work is in compliance with Contract requirements. Required tests and inspections are indicated in each individual Specification Section.
- B. Preparatory Inspection: Performed prior to beginning work and prior to beginning each segment of work and includes:
1. Review of Contract requirements.
  2. Review of shop drawings and other submittal data after return and approval.
  3. Examination to assure materials and equipment conform to Contract requirements.
  4. Examination to assure required preliminary or preparatory work is complete.
- C. Initial Inspection: Performed when representative portion of each segment of work is completed and includes:
1. Performance of required tests.
  2. Quality of workmanship.
  3. Review for omissions or dimensional errors.
  4. Examination of products used, connections and supports.
  5. Approval or rejection of inspected segment of work.
- D. Follow-Up Inspections: Performed daily, and more frequently as necessary, to assure non-complying work has been corrected.
- E. Testing and Inspection: Perform testing and inspection in accordance with requirements in individual Specification Sections.



## **1.6 CONTRACTOR'S DAILY REPORT**

- A. In accordance with the terms and conditions of the contract provisions and clauses, including those concerning *Performance and Superintendence of Work by Contractor*, the Contractor shall submit daily report to Owner's Representative, for days that work was performed. Include the following information:
1. Date, weather, minimum and maximum temperatures, rainfall, and other pertinent weather occurrences.
  2. Daily workforce of Contractor and subcontractors, by trades.
  3. Description of work started, ongoing work, and work completed by each subcontractor.
  4. Coordination implemented between various trades.
  5. Approval of substrates received from various trades.
  6. Nonconforming and unsatisfactory items to be corrected.
  7. Remarks, to include at a minimum, any potential delays, schedule changes, workplace incidents or other items of note. However, nothing reported herein shall relieve the Contractor of the separate responsibility under other terms and conditions of the Contract provisions and clauses to provide specific notice to the Contracting Officer,

## **1.7 CONTRACTOR'S TEST AND INSPECTION REPORTS**

- A. Prepare and submit to Owner's Representative, a written report of each test or inspection signed by Contractor Quality Control Representative performing inspection within 2 days following day inspection was made.
- B. Include the following on written reports of inspection:
1. Cover sheet prominently identifying that inspection "CONFORMS" or "DOES NOT CONFORM" to Contract Documents.
  2. Date of inspection and date of report.
  3. Project name, location, solicitation number, and Contractor.
  4. Names and titles of individuals making inspection, if not Contractor's Project Field Superintendent.
  5. Description of Contract requirements for inspection by referencing Specification Section.
  6. Description of inspection made, interpretation of inspection results, and notification of significant conditions at time of inspection.
  7. Requirements for follow-up inspections.

## **1.8 NON-COMPLIANCE CHECK-OFF LIST**

- A. Maintain check-off list of work that does not comply with Contract Documents, stating specifically what is non-complying, date faulty work was originally discovered, and date work was corrected. No requirement to report deficiencies corrected same day it was discovered. Submit copy of Non-Compliance Check-Off List of non-complying work items to Owner's Representative on a weekly basis.

## **1.9 COMPLETION AND INSPECTION OF WORK**

- A. Prior to final acceptance by Owner's Representative, submit a certification signed by Contractor to Owner's Representative stating that all work has been inspected and all work, except as specifically noted, is complete and in compliance with Contract Documents.

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

### **PART 3 - EXECUTION (Not Applicable)**

**END OF SECTION 014000**

## **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 01 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. Telephone service
  - 6. Sanitary facilities, including drinking water
  - 7. Storm and sanitary sewer
- C. Support facilities include, but are not limited to, the following:
  - 1. Field offices and storage sheds
  - 2. Temporary roads and paving
  - 3. Dewatering facilities and drains
  - 4. Temporary enclosures
  - 5. Hoists and temporary elevator use
  - 6. Temporary project identification signs and bulletin boards
  - 7. Waste disposal services
  - 8. Rodent and pest control
  - 9. Construction aids and miscellaneous services and facilities
- D. Security and protection facilities include, but are not limited to, the following:
  - 1. Temporary fire protection
  - 2. Barricades, warning signs, and lights
  - 3. Sidewalk bridge or enclosure fence for the site
  - 4. 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:
  - 1. For signs and directory boards, provide exterior-type, Grade B-B high-density concrete form overlay plywood of sized and thicknesses indicated.
  - 2. For fences and vision barriers, provide minimum 3/9" (9.5mm) thick exterior plywood.
  - 3. For safety barriers, sidewalk bridges, and similar uses, provide minimum 5/8" (16mm) thick exterior plywood.
- C. 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.
- D. Paint:
  - 1. For sign panels and applying graphics, provide exterior-grade alkyd gloss enamel over exterior primer.
- E. 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.
- F. Open-Mesh Fencing: Provide 0.120" (3mm) thick, galvanized 2" (50mm) chainlink fabric fencing 6' (2m) high with galvanized barbed-wire top strand and 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 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.
- H. 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 Contract Change.
- B. Temporary Water Service: The Owner will provide water for construction purposes from the existing building system. All required temporary extensions shall be provided and removed by the Contractor. Connection points and methods of connection shall be designated and approved by the Construction Representative.
- C. 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.

- 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: Install self-contained toilet units. Use of pit-type privies will not be permitted. Comply with regulations and health codes for the type, number, location, operation, and maintenance of fixtures and facilities. Install where facilities will best serve the Project's needs.
  - 1. Shield toilets to ensure privacy.
  - 2. Provide separate facilities for male and female personnel.
  - 3. Provide toilet tissue materials for each facility.
- F. Wash Facilities: The Owner will provide wash facilities within the building. All construction personnel will be allowed access only to those specific facilities designated by the Construction Representative.
- G. Provide earthen embankments and similar barriers in and around excavations and subgrade construction, sufficient to prevent flooding by runoff of storm water from heavy rains.

### **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. Storage Facilities: Limited areas for storage of building materials are available onsite. Available storage areas are shown on the drawings. The Contractor shall provide his own security. Specific locations for storage and craning operations will be discussed at the Pre-Bid Meeting and the Pre-Construction Meeting.
- C. Construction Parking: Parking at the site will be provided in the areas designated at the Pre-Construction Meeting.
- D. Dewatering Facilities and Drains: For temporary drainage and dewatering facilities and operations not directly associated with construction activities included under individual Sections, comply with dewatering requirements of applicable Division 2 Sections. Where feasible, utilize the same facilities. Maintain the site, excavations, and construction free of water.
- E. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities.
  - 1. Where heat is needed and the permanent building enclosure is not complete, provide temporary enclosures where there is no other provision for containment of heat. Coordinate enclosure with ventilating and materials drying or curing requirements to avoid dangerous conditions and effects.

2. Install tarpaulins securely with incombustible wood framing and other materials. Close openings of 25SqFt (2.3SqM) or less with plywood or similar materials.
  3. Where temporary wood or plywood enclosure exceeds 100SqFt (9.2SqM) in area, use UL-labeled, fire-retardant-treated material for framing and main sheathing.
- F. Temporary Lifts and Hoists: Provide facilities for hoisting materials and employees. Truck cranes and similar devices used for hoisting materials are considered “tools and equipment” and not temporary facilities.
- G. 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.
- H. 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. Barricades, Warning Signs, and Lights: Comply with standards and code requirements for erection of structurally adequate barricades. Paint with appropriate colors, graphics, and warning signs to inform personnel and the public of the hazard being protected against. Where appropriate and needed, provide lighting including flashing red or amber lights.
- B. Enclosure Fence: Before excavation begins, install an enclosure fence with lockable entrance gates. Locate where indicated, or enclose the entire site or the portion determined sufficient to accommodate construction operations. Install in a manner that will prevent people, dogs, and other animals from easily entering the site, except by the entrance gates.
1. Provide open-mesh, chainlink fencing with posts set in a compacted mixture of gravel and earth.
  2. Provide plywood fence, 8’ (2.5m) high, framed with (4) 2”x4” (50mm x 100mm) rails, and preservative-treated wood posts spaced not more than 8’ (2.5m) apart.
- C. Security Enclosure and Lockup: Install substantial temporary enclosure of partially completed areas of construction. Provide locking entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.
1. Storage: Where materials and equipment must be stored and are of value or attractive for theft, provide a secure lockup. Enforce discipline in connection with the installation and release of material to minimize the opportunity for theft and vandalism.



- D. 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.
- C. Termination and Removal: Unless the Designer requests that it be maintained longer, remove each temporary facility when the need has ended, when replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with the temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
  - 1. Materials and facilities that constitute temporary facilities are the Contractor's property. The Owner reserves the right to take possession of project identification signs.
  - 2. Remove temporary paving not intended for or acceptable for integration into permanent paving. Where the area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil in the area. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at the temporary entrances as required by the governing authority.
  - 3. At Substantial Completion, clean and renovate permanent facilities used during the construction period including, but not limited to, the following:
    - a. Replace air filters and clean inside of ductwork and housing.
    - b. Replace significantly worn parts and parts subject to unusual operating conditions.
    - c. Replace lamps burned out or noticeably dimmed by hours of use.

### **END OF SECTION 015000**

## SECTION 016000 - PRODUCT REQUIREMENTS

### 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 selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
  - 1. Division 01, Section 012500 "Substitution Procedures" for requests for substitutions.
  - 2. Division 01, Section 013300 "Submittals" for submittal requirements.
  - 3. Refer to Division 23, Section 260501 "General Mechanical Requirements for Mechanical", Article 1.6 "Codes and Standards" for applicable industry standards for products specified.
  - 4. Refer to Division 26, Section 260500 "Common Work Results for Electrical", Article 1.8 "Reference Standards" for applicable industry standards for products specified.

#### 1.3 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
  - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
  - 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
  - 3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

## 1.4 ACTION SUBMITTALS

- A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
  2. Designer's Action: If necessary, Designer will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Designer will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
    - a. Form of Approval: As specified in Division 01, Section 013300 "Submittals."
    - b. Use product specified if Designer does not issue a decision on use of a comparable product request within time allocated.
  3. Comparable product requests for products indicated in these specifications as "no substitutions" will not be considered.
- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 01, Section 013300 "Submittals." Show compliance with requirements.

## 1.5 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
  2. If a dispute arises between contractors over concurrently selectable but incompatible products, Designer will determine which products shall be used.

## 1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
  2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
  3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.

4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.

## 1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
  2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
  2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
  3. See Divisions 02 through 26 Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Division 00, Section 007213 "General Conditions."

## PART 2 - PRODUCTS

### 2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.

2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Designer will make selection.
5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
6. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or engineer approved equal", or "or designer approved equal", or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.

B. Product Selection Procedures:

1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
3. Products:
  - a. Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.
4. Manufacturers:
  - a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.
5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

## 2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration: Designer will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Designer may return requests without action, except to record noncompliance with these requirements:

1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

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

**END OF SECTION 016000**

## **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 01 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 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 017823 - OPERATION AND MAINTENANCE DATA

### 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 preparing operation and maintenance manuals, including the following:
  - 1. Operation manuals for systems, subsystems, and equipment.
  - 2. Systems and equipment maintenance manuals.
- B. Related Requirements:
  - 1. Division 00, Section 007213 "General Conditions", Article 3.3 "As-Built Drawings"
  - 2. Division 00, Section 007213 "General Conditions", Article 3.5 "Operation and Maintenance Manuals"
  - 3. Division 01, Section 013300 "Submittals" for submitting copies of operation and maintenance manual submittals
  - 4. Divisions 02 through 26 Specification Sections for specific operation and maintenance manual requirements for the Work in those Sections

#### 1.3 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance manual content: See Division 00, Section 007213 "General Conditions", Article 3.5 "Operation and Maintenance Manuals" and Division 00 through 26 Specification Sections. Submit manual content formatted and organized as required by this Section.
  - 1. Designer will comment on whether content of operations and maintenance submittals are acceptable.
  - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operation and maintenance manuals in the following format:
  - 1. For Review and Comments: PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Designer.
  - 2. For Final Submission:

Change in Scope, Re-Bid: Replace Emergency Generator, Infrastructure  
St. Louis Forensic Treatment Center - South, St. Louis, Missouri

M1908-01

- a. PDF Electronic File
- b. Printed Hard Copies: See Division 00, Section 007213 “General Conditions”, Article 3.5 “Operation and Maintenance Manuals” for hard copy count and requirements.

C. Manual Submittal:

1. Submit manuals for review in a sufficient time before final submission is required as per Division 00, Section 007213 “General Conditions”, Article 3.5 “Operation and Maintenance Manuals”. Designer shall review submission and return copy with comments.
2. Correct or revise manual to comply with Designer's comments. Submit revised copy of manual for review.
3. Final Submission: See Division 00, Section 007213 “General Conditions”, Article 3.5 “Operation and Maintenance Manuals” for requirements.

## PART 2 - PRODUCTS

### 2.1 REQUIREMENTS FOR OPERATION AND MAINTENANCE MANUALS

- A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
1. Title page
  2. Table of contents
  3. Manual contents
- B. Title Page: Include the following information:
1. Subject matter included in manual
  2. Name and address of Project
  3. Name and address of Owner
  4. Date of submittal
  5. Name and contact information for Contractor
  6. Name and contact information for Designer
  7. Names and contact information for major consultants to the Designer that designed the systems contained in the manuals
  8. Cross-reference to related systems in other operation and maintenance manuals
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
  - 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.

## 2.2 OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in Division 00 through 26 Specification Sections and the following information:
  - 1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
  - 2. Performance and design criteria
  - 3. Operating standards
  - 4. Operating procedures
  - 5. Operating logs
  - 6. Wiring diagrams
  - 7. Control diagrams
  - 8. Precautions against improper use
  - 9. License requirements including inspection and renewal dates
- B. Descriptions: Include the following:
  - 1. Product name and model number. Use designations for products indicated on Contract Documents.
  - 2. Manufacturer's name
  - 3. Equipment identification with serial number of each component
  - 4. Equipment function
  - 5. Operating characteristics
  - 6. Limiting conditions
  - 7. Performance curves
  - 8. Engineering data and tests
  - 9. Complete nomenclature and number of replacement parts
- C. Operating Procedures: Include the following, as applicable:
  - 1. Startup procedures
  - 2. Equipment or system break-in procedures
  - 3. Routine and normal operating instructions
  - 4. Regulation and control procedures

5. Instructions on stopping
  6. Normal shutdown instructions
  7. Seasonal and weekend operating instructions
  8. Required sequences for electric or electronic systems
  9. Special operating instructions and procedures
- D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

## 2.3 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
1. Standard maintenance instructions and bulletins
  2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly
  3. Identification and nomenclature of parts and components
  4. List of items recommended to be stocked as spare parts
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
1. Test and inspection instructions
  2. Troubleshooting guide
  3. Precautions against improper maintenance
  4. Disassembly; component removal, repair, and replacement; and reassembly instructions
  5. Aligning, adjusting, and checking instructions
  6. Demonstration and training video recording, if available
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.

2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
  1. Include procedures to follow and required notifications for warranty claims.

## **PART 3 - EXECUTION**

### **3.1 MANUAL PREPARATION**

- A. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
- B. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
  1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
- C. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information noted on As-Built Drawings to ensure correct illustration of completed installation.
  1. Do not use original project As-Built Drawings as part of operation and maintenance manuals.
  2. Comply with requirements of Division 00, Section 007213 "General Conditions", Article 3.3 "As-Built Drawings".

## **END OF SECTION 017823**

## **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**

## **SECTION 024119 – SELECTIVE DEMOLITION**

### **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 DESCRIPTION OF WORK**

- A. Furnish all materials, labor, equipment and services necessary to perform all demolition work.
- B. Work included in this Section includes all demolition work as shown on the Drawings and as specified herein and as required to complete the Work.

#### **1.3 RELATED SECTIONS**

- A. Section 230505 – Selective Demolition for HVAC
- B. Section 260505 – Selective Demolition for Electrical

#### **1.4 SUBMITTALS**

- A. Schedule of Selective Demolition Activities: Indicate detailed sequence of selective demolition and removal work, with starting and ending dates for each activity, interruption of utility services, use of elevator and stairs, and locations of temporary partitions and means of egress.
- B. Predemolition Photographs: Show existing conditions of adjoining construction and site improvements, including finish surfaces, which might be misconstrued as damage caused by selective demolition operations.
- C. Landfill Records: If hazardous wastes are removed by contractor, indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

#### **1.5 QUALITY ASSURANCE**

- A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.
- B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- C. Standards: Comply with ANSI A10.6 and NFPA 241, latest editions.
- D. Prior to beginning demolition, arrange a conference with the Construction Representative to review demolition scope, procedures, schedule and items to be salvaged for the Owner.

## **1.6 PROJECT CONDITIONS**

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Construction Representative of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
  - 1. Maintain fire-protection facilities in service during selective demolition operations.

## **1.7 WARRANTY**

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

## **1.8 MATERIALS OWNERSHIP**

- A. Except for items or materials to be reused, salvaged, reinstalled or otherwise indicated to remain the Owner's property, demolished materials shall become the Contractor's property and shall be removed from the site with further disposition at the Contractor's option but in compliance with ordinances and regulations related to the materials being disposed.

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

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION & RECORDING OF CONDITIONS**

- A. Verify that utilities have been disconnected and capped.
- B. Survey existing conditions and coordinate and identify the extent of the demolition work required. Record existing conditions using preconstruction photographs.
- C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged. Use photographs to document conditions.
- D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Construction Representative and Designer.
- E. Engage a professional engineer to survey condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective demolition operations.
- F. Perform surveys as the work progresses to detect hazards resulting from the execution of the work.

### 3.2 COORDINATION

- A. No demolition work shall be performed without prior approval of the Construction Representative.
- B. Demolition work shall be carried on in a manner so as not to interfere with operation of the Owner's plant.
- C. Any demolition work which interferes with Owner's operation shall be scheduled with the Construction Representative and be subject to the Owner's approval.
- D. Maintain existing services required to avert disruption to the Owner's on-going operations and protect them against damage during the performance of the work.
- E. Do not interrupt existing utilities serving occupied facilities except when authorized in writing by the Owner and authorities having jurisdiction.
- F. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and Designer.
- G. Unless noted otherwise, provide not less than two weeks notice to the Owner if shutdown of service is required during the execution of the work.
- H. The Contractor shall not remove any material beyond the limits indicated on the Drawings unless given permission to do so by the Construction Representative. Any such material removed shall be replaced by the Contractor at his expense. If the items removed are damaged and/or cannot be satisfactorily reinstalled, new material of like construction shall be furnished and installed by the Contractor at his expense.
- I. All damages to buildings and utilities to remain in place shall be promptly repaired at no cost to the Owner. Repairs and restoration of accidental utility interruptions shall be made before the workers responsible for the repair and restoration leave the job on the day such interruptions occur.

### 3.3 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
- C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
- D. Existing building openings may be used to remove material. No new openings may be made without approval of the Construction Representative.

### **3.4 PROTECTION**

- A. Comply with governing laws, codes, and regulations governing fire protection and environmental protection during demolition operations.
- B. Provide dust control and ventilation as required in areas of demolition.
- C. Execute demolition work, so as to insure adjacent areas against damage which might occur from falling debris or other causes; do not interfere with the use of, operations in, or around adjacent areas of building; maintain free and safe passage of persons around the areas of demolition.
- D. Provide temporary handrail, barricades, floor plates, etc. as required to provide protection for open elevated platforms, holes, etc. created by the demolition work.
- E. Premises shall be maintained and protected from all unsafe or hazardous conditions at all times.
- F. Protect existing surfaces, active utility services, and equipment which are to remain in place.
- G. No blasting will be permitted.

### **3.5 DUST CONTROL**

- A. Contractor shall use temporary enclosures and other suitable methods as necessary to limit the amount of dust and dirt carrying over to other parts of the Owner's plant.
- B. Adequacy of the dust control methods shall be subject to the approval of the Construction Representative.
- C. Areas of major demolition inside the Owner's plant shall be enclosed by means of temporary walls constructed of wood framing with plywood or 6 mil polyethylene sheets.
- D. Temporary enclosures shall be removed by the Contractor upon completion of the demolition work unless otherwise directed by the Construction Representative.

### **3.6 DEMOLITION - GENERAL**

- A. Remove all work indicated on the drawings and as required to complete the new work indicated.
- B. During demolition operations, keep areas adjacent to demolition work free of dust and debris.
- C. During demolition operations, if suspected hazardous materials or conditions are uncovered, stop work in that area, and inform the Construction Representative.
- D. At concealed spaces, such as hollow walls, ducts, and pipe interiors, verify condition and contents of hidden space before starting demolition operations.
- E. Neatly cut openings and holes plumb, square and true to dimensions, required.
- F. Use cutting methods least likely to damage construction to remain or adjoining construction.



- G. To minimize disturbance of adjacent surfaces, use hand or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
- H. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
- I. Do not use cutting torches until work area is cleared of flammable materials.
- J. Maintain portable fire-suppression devices during flame-cutting operations.
- K. Contractor shall take care when using a torch to cut steel welded or bolted to the building structural members so as to cut flush with but not damage the building structural members.
- L. All hanger and support material for demolished piping and conduit shall be removed back to the primary structural support member. Grind connection to primary member smooth and touch up with paint to match adjacent surface.
- M. All elevated equipment and materials to be demolished shall be carefully lowered (not dropped) by means of temporary riggings. Contractor shall not overload any elements of existing structure during the rigging operation.
- N. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
- O. Dispose of demolished items and materials promptly.

### **3.7 CONCRETE AND MASONRY DEMOLITION**

- A. Demolish concrete and masonry in small sections.
- B. Cut concrete and masonry at junctures with construction to remain, using power driven masonry saw or hand tools. Do not use power-driven impact tools.

### **3.8 WALL AND FLOOR COVERING DEMOLITION**

- A. Wall covering removal and residual adhesive: as required to provide a wall substrate suitable for the application of the new wall finishes.
- B. Carpet and residual adhesive removal: as required to provide a floor substrate suitable for the application of the new flooring.
- C. Resilient floor covering and residual adhesive: Remove in accordance with the recommendations of the Resilient Floor Covering Institute (RFCI) "Recommended Work Practices for the Removal of Resilient Floor Coverings" and referenced applicable ASTM publications such as ASTM F-710 (latest version) Standard Practice for Preparing Concrete Floors and Other Monolithic Floors to Receive Resilient Flooring.
- D. Remove residual adhesive. Leave floor suitable for the application of the new flooring contractor to prepare substrate for new floor coverings by one of the methods in the RFCI.

### **3.9 PIPING DEMOLITION**

- A. The Contractor shall use caution in the demolition of piping and shall inform himself of the conditions (fluid, pressure, temperature) of all piping systems to be demolished before making any cuts or breaking any joints.
- B. Prior to breaking or cutting piping or tubing within the demolition area, the Contractor shall ascertain that the system has been marked in the field or shown on the Drawings to be wrecked under this contract. Contact Construction Representative for clarification prior to demolishing or wrecking questionable items.
- C. Arrange for shutoff, isolation, and lock-out of piping with Construction Representative or utility companies.
- D. When indicated on the drawings, before proceeding with selective demolition, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
- E. All remaining piping with open ends resulting from demolition work shall be promptly capped, plugged or blind flanged.

### **3.10 ELECTRICAL DEMOLITION**

- A. See Section 260505 – Selective Demolition for Electrical in these Specifications.

### **3.11 PATCHING**

- A. All rough edges of openings created by demolition shall be promptly patched to create a finished surface.
- B. Openings in concrete shall be patched with cement mortar.
- C. Openings in masonry shall be patched by toothing in masonry units to match existing.

### **3.12 REMOVED AND SALVAGED ITEMS**

- A. Clean salvaged items.
- B. Pack or crate items after cleaning. Identify contents of containers.
- C. Store items in a secure area until delivery to Owner.
- D. Transport items to Owner's storage area on-site designated by Owner.
- E. Protect items from damage during transport and storage.
- F. The following items are to be salvaged after removal, cleaned and crated as indicated above, and loaded onto a trailer to be provided by the Owner at the project site:
  - 1. Existing diesel-engine-driven generator set, including weatherproof enclosure, access stairs and platform, structural steel base rails and all items within the generator set weatherproof enclosure.
  - 2. Existing ATS-1 (for fire pump)

3. Existing ATS-4 (150A with bypass)

### **3.13 REMOVED AND REINSTALLED ITEMS**

- A. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
- B. Pack or crate items after cleaning and repairing. Identify contents of containers.
- C. Protect items from damage during transport and storage.
- D. Reinstall items in locations indicated.
- E. Comply with installation requirements for new materials and equipment.
- F. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

### **3.14 EXISTING ITEMS TO REMAIN**

- A. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition.
- B. When permitted by the Construction Representative, items may be removed to a suitable, protected storage location during selective demolition and reinstalled in their original locations after selective demolition operations are complete.

### **3.15 DISPOSAL**

- A. All debris resulting from demolition operations shall become the property of the Contractor and shall be removed daily from the Owner's property unless otherwise permitted by the Construction Representative.
- B. Storage of removed materials on site will not be permitted.
- C. The on-site sale of removed equipment and materials will not be permitted.
- D. Transport demolished materials off Owner's property and dispose of legally.
- E. Upon completion of work, remove tools, materials, apparatus, and rubbish. Leave area clean, neat, and orderly.

### **3.16 CLEANING**

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations.
- B. Return adjacent areas to condition existing before selective demolition operations began.

### **3.17 HAZARDOUS MATERIALS**

- A. The Owner, to the best of his knowledge, does not believe that hazardous materials containing friable asbestos or lead are included in the items to be demolished or the work areas.

- B. Should the Contractor discover material requiring removal, which is suspected to contain hazardous materials, do not disturb.
- C. Contact and consult with the Construction Representative prior to proceeding. The Construction Representative shall direct the Contractor how to proceed.

**END OF SECTION 024119**

## **SECTION 031000 - CONCRETE FORMING AND ACCESSORIES**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes
  - 1. Formwork for cast-in place concrete, with shoring, bracing and anchorage.
  - 2. Openings for other work.
  - 3. Form accessories.
  - 4. Form stripping.
- B. Related Documents: The Contract Documents, as defined in Section 011000 - Summary of Work, apply to the Work of this Section. Additional requirements and information necessary to complete the Work of this Section may be found in other documents.
- C. Related Sections:
  - 1. Section 032000 - Concrete Reinforcement: Coordination between formwork and reinforcement.
  - 2. Section 033000 - Cast-in-Place Concrete: Supply of concrete accessories for placement by this section.

#### **1.2 REFERENCES**

- A. American Concrete Institute (ACI) Codes and Standards latest editions:
  - 1. ACI 301 - Structural Concrete for Buildings.
  - 2. ACI 318 - Building Code Requirements for Reinforced Concrete.
  - 3. ACI 347 - Recommended Practice For Concrete Formwork.
- B. United States Department of Commerce Product Standard (PS):
  - 1. PS 1 - Construction and Industrial Plywood.

#### **1.3 SUBMITTALS**

- A. Section 013300 - Submittal Procedures: Procedures for submittals.
  - 1. Product Data: Provide data on void form materials and installation requirements. Submit data on form-coating materials.
  - 2. Shop Drawings: Indicate pertinent dimensions, materials, required installation and removal of bracing, shoring and arrangement of joints and ties.

#### **1.4 QUALITY ASSURANCE**

- A. Perform Work in accordance with ACI 347.
- B. Where necessary, design formwork, shoring under direct supervision of a Professional Engineer experienced in design of formwork and licensed in State where Project is located.

## **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Section 016000 - Product Requirements: Transport, handle, store, and protect products.
- B. Deliver void forms and installation instructions in manufacturer's packaging.
- C. Store off ground in ventilated and protected manner to prevent deterioration from moisture.

## **1.6 ENVIRONMENTAL REQUIREMENTS**

- A. Environmental Impact:
  - 1. Formwork: Reuse forms to greatest extent possible without damaging structural integrity of concrete and without damaging aesthetics of exposed concrete.

## **PART 2 - PRODUCTS**

### **2.1 WOOD FORMS**

- A. Forms for Exposed Finish Concrete: Plywood panels, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on drawings.
  - 1. Plywood complying with U.S. Product Standard PS-1 "B-B (Concrete Form) Plywood," Class I, Exterior Grade or better, mill-oiled and edge-sealed, with each piece bearing legible inspection trademark.
- B. Forms for Unexposed Finish Concrete: Plywood, lumber, metal, or other acceptable material. Provide lumber dressed on at least 2 edges and one side for tight fit.
- C. Lumber: Construction grade; with grade stamp clearly visible.

### **2.2 PREFABRICATED FORMS**

- A. Preformed Steel Forms: Minimum 16 gage, well matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.
- B. Tubular Column Type: Metal or fiberglass-reinforced plastic. Provide units with sufficient wall thickness to resist wet concrete loads without deformation.

### **2.3 ACCESSORIES**

- A. Form Ties: Factory-fabricated, removable or snap-off type, metal, of fixed or adjustable length as applicable, with cone ends. Designed to prevent form deflection and to prevent spalling concrete upon removal. Back break dimension, 1-1/2 inch from exposed concrete surface. Provide ties that, when removed, will leave holes not larger than 1-inch diameter in concrete surface.
- B. Form Release Agent: 100 percent biodegradable colorless agent which will not stain concrete, or absorb moisture, or impair natural bonding or color characteristics of subsequent coatings intended for use on concrete surfaces. Zero VOC.
  - 1. Envirolux by Conspec, Kansas City, KS, (800) 348-7351 or (913) 287-1700.

2. SMD-10 Soy Form Release by Strategic Market Development (800) 959-1071 or (815) 935-0863.
  3. Bio-Form by Leahy-Wolf, Franklin Park, IL, (888) 873-5327 or (847) 455-5710.
  4. Section 016000 - Product Requirements: Product options and substitutions. Substitutions: Permitted.
- C. Corners: Chamfered, wood strip 3/4 x 3/4 inch size; maximum possible lengths.
- D. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Section 017300 - Execution: Verification of existing conditions before starting work.
- B. Verification of Conditions: Verify that field measurements, surfaces, and conditions are as required, and ready to receive Work.
1. Verify lines, levels and centers before proceeding with formwork. Ensure that dimensions agree with Drawings.
- C. Report in writing to Contracting Officer prevailing conditions that will adversely affect satisfactory execution of the Work of this Section. Do not proceed with Work until unsatisfactory conditions have been corrected.
- D. By beginning Work, Contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to United States Postal Service.

### **3.2 FORMWORK INSTALLATION**

- A. Install formwork, shoring and bracing to achieve design requirements, in accordance with requirements of ACI 347R.
- B. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to overstressing by construction loads.
- C. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores upon approval by the Professional Engineer responsible for their design.
- D. Align joints and make watertight. Furnish in largest available sizes to minimize number of joints and to conform to joint system indicated on Drawings.
- E. Obtain approval from the Engineer or Architect before framing openings in structural members which are not indicated on Drawings.
- F. Provide chamfer strips on external corners of concrete members, to produce uniform, smooth lines and tight edge joints.

### **3.3 FORM RELEASE AGENT APPLICATION**

- A. Apply form release agent on formwork in accordance with manufacturer's published instructions.
- B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.
- C. Do not apply form release agent where concrete surfaces will receive special finishes or applied coverings which are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

### **3.4 INSERTS, EMBEDDED PARTS, AND OPENINGS**

- A. Provide formed openings where required for items to be embedded in passing through concrete work.
- B. Locate and set in place items which will be cast directly into concrete.
- C. Coordinate with work of other sections in forming and placing openings, slots, recesses, sleeves, bolts, anchors, other inserts, and components of other Work.
- D. Install accessories in accordance with manufacturer's published instructions, straight, level, and plumb. Ensure items are not disturbed during concrete placement.
- E. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.
- F. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

### **3.5 FORM CLEANING**

- A. Clean forms as erection proceeds, to remove foreign matter within forms.
- B. Clean formed cavities of debris prior to placing concrete.
- C. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.
- D. During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure. Use compressed air or other means to remove foreign matter.

### **3.6 CONSTRUCTION**

- A. Site Tolerances:
  - 1. Construct formwork to maintain tolerances required by ACI 301 and ACI 347.
  - 2. Camber slabs and beams 1/4 inch per 10 feet in accordance with ACI 301.

### **3.7 FIELD QUALITY CONTROL**

- A. Section 014000 - Quality Requirements: Field inspection and testing.



- B. Inspect erected formwork, shoring [, and reshoring], and bracing to ensure that work is in accordance with formwork design, and that supports, fastenings, wedges, ties, and items are secure.

### **3.8 FORM REMOVAL**

- A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.
- B. Do not remove shoring without approval from the Professional Engineer responsible for their design.
- C. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.
- D. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged. Discard damaged forms.

**END OF SECTION 031000**

## **SECTION 032000 – CONCRETE REINFORCEMENT**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Reinforcing steel bars.
  - 2. Steel wire mesh.
  - 3. Reinforcement accessories.
- B. Related Documents: The Contract Documents, as defined in Section 011000 - Summary of Work, apply to the Work of this Section. Additional requirements and information necessary to complete the Work of this Section may be found in other documents.
- C. Related Sections:
  - 1. Section 031000 - Concrete Forming and Accessories: Coordination between formwork and reinforcing.
  - 2. Section 033000 - Cast-in-Place Concrete: Coordination between concrete placement and reinforcing.

#### **1.2 REFERENCES**

- A. American Concrete Institute (ACI):
  - 1. ACI 301 - Structural Concrete for Buildings.
  - 2. ACI 318 - Building Code Requirements For Reinforced Concrete.
  - 3. ACI SP-66 - American Concrete Institute - Detailing Manual.
- B. American Society for Testing and Materials (ASTM):
  - 1. ASTM A 184 - Fabricated Deformed Steel Bar Mats for Concrete Reinforcement.
  - 2. ASTM A 615 - Deformed and Plain Billet Steel Bars for Concrete Reinforcement.
  - 3. ASTM A 704 - Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement.
- C. American Welding Society (AWS):
  - 1. AWS D1.4 - Structural Welding Code for Reinforcing Steel.
- D. Concrete Reinforcing Steel Institute (CRSI):
  - 1. CRSI - Manual of Practice.
  - 2. CRSI 63 - Recommended Practice For Placing Reinforcing Bars.
  - 3. CRSI 65 - Recommended Practice For Placing Bar Supports, Specifications and Nomenclature.

#### **1.3 SUBMITTALS**

- A. Section 013300 – Submittal Procedures: Procedures for submittals.

1. Shop Drawings: Indicate bar sizes, spacings, locations, and quantities of reinforcing steel and wire fabric, bending and cutting schedules, and supporting and spacing device. Include special reinforcement required for openings through concrete structures.
2. Assurance/Control Submittals;
  - a. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
  - b. Submit certified copies of mill test report of reinforcement materials analysis.
  - c. Welder's Certificates.

## **1.4 QUALITY ASSURANCE**

- A. Perform Work in accordance with CRSI 63, 65 and Manual of Practice ACI 301, ACI SP-66, ACI 318, and ASTM A 184.
- B. Design reinforcement under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State where the Project is located.
- C. Welders' Certificates: Submit certificate, certifying welders employed on the Work, verifying AWS qualification within the previous 12 months.

## **PART 2 - PRODUCTS**

### **2.1 STEEL REINFORCEMENT**

- A. Reinforcing Steel: ASTM A 615, 60 ksi yield grade; deformed billet steel bars, epoxy coated per ASTM A 775, with less than 2 percent damaged coating in each 12-inch bar length. Fabrication, handling and repairs shall be per ASTM D 3963.
- B. Reinforcing Steel Mesh: ASTM A185; 6X6, w 1.4 X w 1.4, epoxy coated.
- C. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A 775.

### **2.2 ACCESSORIES**

- A. Epoxy-Coated Wire: ASTM A 884, Class A, Type 1 coated, as-drawn, plain steel wire, with less than 2 percent damaged coating in each 12-inch wire length.
- B. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during concrete placement conditions including continuous bearing wires and/or load bearing pad on bottom to prevent Geofoam puncture as required. Manufacture bar supports from steel wire or plastic according to CRSI's "Manual of Standard Practice," and as follows:
  1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected or CRSI Class 2 stainless-steel bar supports.
  2. For epoxy-coated reinforcement or dowels, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

- C. Mechanical splices: mechanical splices shall be uni-axial type capable of developing 125 percent of the specified yield strength of the bar in tension.
  - 1. Epoxy-coated mechanical splices shall be used with epoxy-coated reinforcing bars.
  - 2. Submit copies of mill test reports of steel used in the fabrication of reinforcing couplers showing the chemical and mechanical properties.

## **2.3 FABRICATION**

- A. Fabricate concrete reinforcing in accordance with ACI SP-66 and ACI 318.
- B. Welding of reinforcement is not permitted.
- C. Locate reinforcing splices not indicated on drawings, at point of minimum stress. Review location of splices with Contracting Officer.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Section 017300 - Execution: Verification of existing conditions before starting work.
- B. Verification of Conditions: Verify that field measurements, surfaces, and conditions are as required, and ready to receive Work.
- C. Report in writing to Contracting Officer prevailing conditions that will adversely affect satisfactory execution of the Work of this Section. Do not proceed with Work until unsatisfactory conditions have been corrected.
- D. By beginning Work, Contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to United States Postal Service.

### **3.2 PLACEMENT**

- A. Place, support and secure reinforcement against displacement. Do not deviate from required position.
- B. Do not displace or damage vapor barrier.
- C. Accommodate placement of formed openings.
- D. Maintain concrete cover around reinforcing in accordance with ACI 318.

### **3.3 FIELD QUALITY CONTROL**

- A. Section 014000 - Quality Requirements: Field inspection.
- B. Inspect reinforcing locations, bar types and sizes, wire ties, and welding (if applicable).

**END OF SECTION 032000**

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## **SECTION 033000 – CAST-IN-PLACE CONCRETE**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Includes all labor, materials and appliances, and perform all operations in connection with the installation of Concrete Work, and all related work incidental to the completion thereof, as shown on the drawings, complete, in strict accordance with the drawings and as specified herein. Section Includes:
  - 1. Cast-in-place (CIP) concrete in building frame elements, walls, foundations, foundation walls, slabs-on-grade, and mechanical equipment pads.
  - 2. Finishing of concrete floor slabs and toppings. Concrete liquid surface treatment, sealer, and slip-resistant coatings.
  - 3. Expansion and contraction, control joints in CIP concrete.
  - 4. Concrete curing and protection.
  - 5. Non-shrink grout including installation and forming.
  - 6. Testing related services.
- B. Related Documents: The Contract Documents, as defined in Section 011000 - Summary of Work, apply to the Work of this Section. Additional requirements and information necessary to complete the Work of this Section may be found in other Documents and References in Section 1.2.
- C. Related Sections: Related work specified elsewhere includes but may not be limited to
  - 1. Section 014000 – Quality Requirements
  - 2. Section 031000 – Concrete Forming and Accessories
  - 3. Section 032000 – Concrete Reinforcement

#### **1.2 REFERENCES**

- A. General:
  - 1. The publications listed below form a part of this specification to the extent referenced.
  - 2. Where a date is given for reference standards, the edition of that date shall be used. Where no date is given for reference standards, the latest edition available on the date of bidding shall be used.
- B. American Association of State Highway and Transportation Officials (AASHTO)
  - 1. AASHTO M182, “Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats.”
- C. Unless otherwise shown or specified, the work shall conform to the following standards and recommendations of the American Concrete Institute (ACI), latest editions adopted:
  - 1. ACI 117, “Standard Specification for Tolerances for Concrete Construction and Materials.”

2. ACI 121R, "Quality Assurance Systems for Concrete Construction."
3. ACI 211.1, "Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete."
4. ACI 212.2R, "Guide for Use of Admixtures in Concrete."
5. ACI 214, "Recommended Practice for Evaluation of Strength Test Results of Concrete."
6. ACI 301, "Specification for Structure /Concrete."
7. ACI 302.1R, "Guide for Concrete Floor and Slab Construction."
8. ACI 304R, "Guide for Measuring, Mixing, Transporting, and Placing Concrete."
9. ACI 304.2-R, "Placing Concrete by Pumping Methods."
10. ACI 305, "Hot Weather Concreting."
11. ACI 306, "Cold Weather Concreting."
12. ACI 306.1 "Standard Specification for Cold Weather Concreting."
13. ACI 308, "Standard Practice for Curing Concrete."
14. ACI 309R, "Guide for Consolidation for Concrete."
15. ACI 315, "Details and Detailing of Concrete Reinforcement."
16. ACI 318, "Building Code Requirements for Structural Concrete."
17. ACI 347, "Guide to Formwork for Concrete."
18. ACI 347.2R "Guide for Shoring/Reshoring of Concrete Multistory Buildings."
19. ACI 503.2, "Standard Specification for Bonding Plastic Concrete to Hardened Concrete with a Multi-Component Epoxy Adhesive."
20. ACI SP-15, "Field Reference Manual" which includes ACI 301 "Specifications for Structural Concrete for Buildings" and reference standards specified therein.

D. American Welding Society (AWS)

1. AWS D1.4, "Structural Welding Code Reinforcing."

E. American Society for Testing and Materials (ASTM).

1. ASTM A615, "Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement."
2. ASTM C31, "Standard Practice for Making and Curing Concrete Test Specimens in the Field."
3. ASTM C33, "Standard Specification for Concrete Aggregates."
4. ASTM C39, "Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens."
5. ASTM C42, "Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete."
6. ASTM C94, "Standard Specification for Ready-Mixed Concrete."
7. ASTM C109, "Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens)"

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8. ASTM C114, "Standard Test Method for Chemical Analysis of Hydraulic Cement."
9. ASTM C138, "Standard Test Method for Unit Weight, Yield, and Air Content of Concrete (Gravimetric) of Concrete."
10. ASTM C143, "Standard Test Method for Slump of Hydraulic Cement-Cement Concrete."
11. ASTM C150, "Standard Specification for Portland Cement."
12. ASTM C156, "Standard Test Method for Water Retention by Concrete Curing Materials."
13. ASTM C171, "Standard Specification for Sheet Materials for Curing Concrete."
14. ASTM C173, "Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method."
15. ASTM C231, "Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method."
16. ASTM C260, "Standard Specification for Air Entraining Admixtures for Concrete."
17. ASTM C309, "Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete."
18. ASTM C311, "Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland-Cement Concrete."
19. ASTM C387, "Standard Specification for Packaged, Dry, Combined Materials for Mortars and Concrete."
20. ASTM C457, "Standard Test Method for Microscopical Determination of Parameters of the Air-Void System in Hardened Concrete."
21. ASTM C494, "Standard Specification for Chemical Admixtures for Concrete."
22. ASTM C618, "Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete."
23. ASTM C920, "Standard Specification for Elastomeric Joint Sealants."
24. ASTM C685, "Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing."
25. ASTM C989, "Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars."
26. ASTM C 1116, "Standard Specification for Fiber-Reinforced Concrete and Shotcrete."
27. ASTM C1260, "Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)."
28. ASTM C1567, "Standard Test Method for Potential Alkali Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)."
29. ASTM E154, "Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Slabs, On Walls, or as Ground Cover."



30. ASTM E1155, "Standard Test Method for Determining F Floor Flatness and FL Floor Levelness Numbers"
  31. ASTM D2240, "Standard Test Method for Rubber Property-Durometer Hardness."
- F. Concrete Reinforcing Steel Institute (CRSI),
1. CRSI "Manual of Standard Practice."

### 1.3 SUBMITTALS

A. Section 013300 - Submittal Procedures: Procedures for submittals.

1. Review of submittals will cover general design only. In no case shall submittal review relieve the Contractor of the responsibility for strength of concrete, general or detailed dimension, quality or quantity of materials, or any other conditions, functions, performance or guarantees required.
2. Product Data:
  - a. Manufacturers' literature containing product and installation specifications and details.
  - b. Where Manufacturer's specifications, recommendations, and/or directions are required in this specification, deliver two (2) copies of such printed specifications, recommendations, and/or directions for approval before any work is commenced.
  - c. Sources of fine and coarse aggregate. Once approved, the source of fine and coarse aggregate shall not be changed without written approval of the Engineer.
  - d. List of manufacturers and brand names for cement, mineral and liquid admixtures, bond breakers, curing compounds, anchor adhesive, joint sealants, and materials other than aggregates and reinforcing steel. Include product data sheets, instructions, and specifications for use.
3. Shop Drawings:
  - a. All shop drawings and calculations must bear the seal and signature of an engineer registered in the jurisdiction where project is being constructed.
  - b. Cast-in-place concrete shown on structural drawings, prepared under the supervision of a registered Professional Engineer, including:
    - 1) Rebar placing drawings (ACI 315, "Detailing Manual SP-66-(04)" or CRSI "Manual of Standard PracticeMSP-2-81"): Show bar sizes, bending, placing, spacing, locations, and quantities of reinforcing and wire fabric and supporting and spacing accessories. Provide steel order lists including bending and cutting details for all reinforcement shown on the structural design drawings.
    - 2) Form construction details, including jointing, special formed joints or reveals, location and pattern of form tie placement, and other items that affect exposed concrete visually.
    - 3) Calculations for any formwork, shoring and/or reshoring.
4. Batch Plant Equipment and Procedures

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- a. Supplier of concrete and ready-mix grout. Only one source will be approved for the Contractor, including all subcontractors. All concrete and ready-mixed grout supplied to the project shall originate from the approved single facility.
  - b. The following information shall be submitted:
    - 1) Name of supplier.
    - 2) Plant location.
    - 3) Plant volume and output capacity.
    - 4) Capacity of transit equipment.
    - 5) Estimated travel time from plant to jobsite.
  - c. If the Contractor elects to use an on-site concrete batching plant, the following information shall be submitted:
    - 1) Drawings and data including proposed location of the batch plant on the site.
    - 2) List of and performance data for material handling equipment.
    - 3) Procedures for processing, handling, transporting, sorting, and proportioning the materials for concrete.
  - d. All other data necessary to show the supplier's capability to produce concrete of the quality and quantity required.
5. Concrete Procedures
- a. The following information shall be submitted:
    - 1) Placement drawings for slab-on-grade shall be submitted indicating location and size, placement sequence, joint locations, and embedded items.
    - 2) Procedure for mixing and transporting concrete to the point of placement.
    - 3) Procedures for placement of concrete.
    - 4) Methods of obtaining and maintaining the required concrete temperature during placement and initial curing.
    - 5) Procedures for consolidating the concrete.
    - 6) Procedures how concrete is finished and cured (slab-on-grade concrete).
6. Assurance/Control Submittals:
- a. Test Reports: Submit the following reports directly to Owner's Representative from Testing Laboratory, with copy to Contractor. Prepare reports in conformance with Section 014000 - Quality Requirements:
  - b. Submit laboratory test reports for concrete materials and mix design test, including certified copy of results of aggregate tested by ASTM C1260 or C1567. Mix designs for each strength and type of concrete proposed for use. Details to be included are found in section 2.7.

- c. Certificates: Manufacturer's certificate that Products meet or exceed specified requirements.
  - d. Qualification Documentation: Submit documentation of experience indicating compliance with specified qualification requirements.
  - e. Anchor Adhesive:
    - 1) ICC-ES Evaluation Reports
    - 2) Manufacturer's installation instructions.
    - 3) Installer Qualifications & Procedures: Submit installer qualifications as stated in Section 1.4.A.3. Submit a letter of procedure stating method of drilling, the product proposed for use, the complete installation procedure, manufacturer training date, and a list of the personnel to be trained on anchor installation.
7. Delivery Tickets:
- a. Copies of delivery tickets for each load of concrete delivered to site.
  - b. Indicate on each ticket information required by ASTM C94 including additional information required herein.
  - c. Mix identification number on ticket shall match number on submitted and approved mix design
  - d. Indicate number of drum revolution from when water is added until concrete is discharged.
  - e. Submit copies to Testing Laboratory same day as concrete delivery.
- B. Section 017704 – Closeout Procedures and Training: Procedures for closeout submittals.
- 1. Project Record Documents: Accurately record the following:
    - a. Shop drawings shall be corrected to reflect actual field changes and become part of the "Record As-Built Drawings".
  - 2. Extra Products: Submit extra products as specified in this Section.

## 1.4 QUALITY ASSURANCE

- A. Qualifications:
- 1. Manufacturer: Company specializing in manufacturing Products specified with minimum 5 years documented experience.
  - 2. Installer: Company specializing in performing the Work of this Section with minimum 5 years documented experience.
  - 3. Adhesive Anchor Installers:
    - a. Qualifications: Specialist in installation of adhesively-set anchors in concrete who is certified as an Adhesive Anchor Installer through a qualifying ACI/CRSI-sanctioned testing and certification program.
    - b. Installer Training: Conduct a thorough training with the manufacturer or the manufacturer's representative for the installer on the project. Training to consist of a review of the complete installation process for drilled-in anchors, to include but not limited to:

- 1) hole drilling procedure
  - 2) hole preparation & cleaning technique
  - 3) adhesive injection technique & dispenser training/maintenance
  - 4) rebar dowel preparation and installation
  - 5) proof loading/torqueing
- c. Certifications: Unless otherwise authorized by the Engineer, anchors shall have the following certification:
- 1) ICC-ES Evaluation Report indicating conformance with current applicable ICC-ES Acceptance Criteria.

## **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Section 016000 – Product Requirements: Transport, handle, store, and protect Products.
- B. Deliver materials in unopened containers with labels identifying contents.
- C. Store powdered materials in dry area and in manner to prevent damage. Protect liquid materials from freezing or exceeding maximum storage temperatures set by product manufacturer.

## **1.6 PROJECT CONDITIONS OR SITE CONDITIONS**

- A. Jobsite Requirements:
1. Conform to ACI 305 R when placing concrete during hot weather.
  2. Conform to ACI 306 R when placing concrete during cold weather.

## **1.7 ENVIRONMENTAL REQUIREMENTS**

- A. Resource Management:
1. Recycled Content:
    - a. Concrete: Fly ash may be used as a substitute for a maximum of 25 percent of Portland cement.
- B. Environmental Impact:
1. Concrete placement accessories:
    - a. Mixing equipment: Return excess concrete to supplier; minimize water used to wash equipment.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with project requirements, manufacturers offering Products which may be incorporated in the Work include the following:

1. Applied Concrete Technology, Inc., Post Office Box 548, Grayslake, IL 60030, Toll Free: 800-228-6694, Phone: 847-548-2444, Fax: 847-548-2555, [www.protecrete.com](http://www.protecrete.com)
  2. The Euclid Chemical Company, 19218 Redwood Road, Cleveland, OH 44110, Phone: 216-1-9222, Toll Free: (800) 321-7628, Fax: 216-531-9596 [www.euclidchemical.com](http://www.euclidchemical.com).
  3. ChemRex Inc., Shakopee, Minnesota 55379, Toll Free: 800-433-9517, Fax: 800-496-6067.
  4. BASF Construction Chemicals North America (former Master Builders), 23700 Chagrin Boulevard, Cleveland, OH 44122, Phone: 216-839-7500, Fax: 216-839-8821.
  5. W.R. Meadows, Inc., PO Box 338, Hampshire, Illinois 60140-0338, Toll Free: 800-342-5976, Phone: 847-683-4500.
  6. Reef Industries, 9209 Almeda Genoa, Houston, Texas 77075, Phone: 713-507-4251, Toll Free: 800-231-6074, Fax: 713-507-4295.
  7. Stego Industries LLC, 27442 Calle Arroyo Suite A, San Juan, Capistrano, CA 92675, Phone: 877-464-7834, Fax: 949-493-5165, [www.stegoindustries.com](http://www.stegoindustries.com).
  8. L & M Construction Chemicals, Inc. 14851 Calhoun Rd., Omaha, NE 68152-1140; Phone: 402-453-6600, Fax: 402-453-0244.
  9. Curecrete Chemical Company, Inc., 1203 W. Spring Creek Pl., Springville, UT Phone: 801- 489-5663.
  10. Midwest Floor Care Inc., 17202 Princeton Rd, Adams, NE 68301, Phone: 402-788-2820.
  11. General Resource Technology, Inc., 2978 Center Court, Eagan, MN 55121, Phone: 800-324-8154, Fax: 651-454-4252, [www.grtinc.com](http://www.grtinc.com).
  12. W. R. Grace & Co., 7500 Grace Dr, Columbia, MD 21044, Phone: (410) 531-4000; <https://grace.com/en-us>
  13. Hilti Corporation, 1-800-879-8000, [www.hilti.com](http://www.hilti.com)
- B. Section 016000 – Product Requirements: Product options and substitutions. Substitutions: Permitted.

## 2.2 CONCRETE MATERIALS

- A. Concrete shall be in accordance with ASTM C94. If a conflict exists between ASTM C94 and these specifications, these specifications shall govern.
- B. Portland Cement: ASTM C150 – Type I unless otherwise specified or approved by the Engineer.
  1. Assume full responsibility for the quality and soundness of cement. Cement is to be of one type and from the same mill; it is to be of uniform color for all concrete with permanently exposed concrete finishes.
- C. Liquid admixtures: All admixtures shall be used in conformance with the manufacturer's recommendations. When air entraining admixtures, water reducing admixtures, high range water reducing admixtures, and non-corrosive accelerating admixtures are used in any

combination, all products shall be from the same manufacturer or the ready-mix concrete producer shall certify that they are compatible. The following admixtures are permitted when approved in writing prior to use or are required as specified herein and shall be used in strict accordance with the manufacturer's specifications or recommendations:

1. Calcium chloride: Conform to ACI 301. The water-soluble chloride ion level shall not exceed 0.3 percent by weight of cement.
2. Air-entraining admixtures: ASTM C260 shall be used to achieve the specified air content in all permanently exposed exterior concrete. For steel hard trowel interior slab finish, do not use air entrainment admixtures. The total air entrainment (entrained and entrapped air) must not exceed 3 percent. For steel trowel exterior slab finish, comply with ACI 318 and ACI 302.
  - a. Euclid: AEA-92 or Air Mix 200.
  - b. BASF: Micro-Air, MBVR-Standard, and MB AE 90.
  - c. Sika: Sika AEA-14, Sika AEA-15, and Sika Air.
  - d. W.R. Grace: Darex EH, Darex II AEA, Daravair AT60, Daravair 1400, and Daravair 1000.
3. Water-reducing admixtures: Conform to ASTM C494, Type A, containing not more chloride ions than allowed in paragraph C., above.
  - a. Euclid: Eucon WR series or Eucon MR.
  - b. BASF: Masterpave, Masterpave N, PolyHeed 997, Pozzoloth 220N, and Glenium 7500.
  - c. W.R. Grace: Daracem 55 and Daracem 65, WRDA 82 and WRDA with HYCOL.
  - d. Sika: Sikament HP, Plastocrete 161, and Sikament 686.
  - e. General Resource Technology: Polychem 400 NC and Polychem 1000.
4. Water-reducing/accelerating admixtures: Conform to ASTM C494, Type C or E having long-term test results showing non-rusting on metal deck and reinforcing steel.
  - a. Euclid: Accelguard series.
  - b. BASF: Pozzutec 20+, Pozzoloth NC 534, and Rheocrete CNI.
  - c. Sika: Sika Rapid-1 and Plasocrete 161FL.
  - d. W.R. Grace: Lubricon NCA, Polarset, and DCI.
5. Water-reducing/retarding admixtures: Conform to ASTM C494, Type D containing not more than 1 percent chloride ions.
  - a. Euclid: Eucon Retarder series.
  - b. BASF: Delvo Stabilizer, Masterpave series, and Pozzoloth 100XR, 200N, 220N and 322N.
  - c. Sika: Plastimet.
  - d. W.R. Grace: Daratard 17, WRDA-64, and WRDA-82.

6. High-range/water-reducing (HRWR) admixtures: Conform to ASTM C494, Type F or G super plasticizers containing 1 percent maximum chloride ions may be used with low slump (3 inches maximum) concrete to produce flowable concrete (up to 8 inches slump) with early strength gain and 28-day strengths equal to reference concrete. HRWR admixture may be used providing not more than 60 minutes is allowed from addition of admixture to final placement of concrete. HRWR admixture shall be used in concrete with a maximum water/ cement ratio of 0.50 or less and is suggested in the following:
  - a. In pumped concrete.
  - b. In concrete topping slabs
  - c. In lieu of the specified water-reducing admixture (Type A) where confinement of placing due to heavy reinforcement or narrow space requires flowable concrete.
  - d. Where more than 30 minutes is required between the addition of admixtures to final placement of the concrete, a combination of water-reducing, set controlling admixtures (ASTM C494, Types A, D, & E) as in Master Builders Company "Synergized Performance System" may be used.
    - 1) Euclid: Eucon 37 or Eucon 537.
    - 2) BASF: Rheobuild 1000, Glenium 3000 NS, and Glenium 3400NV.
    - 3) Sika: Sikament 300, Viscocrete 2100, and Sikament 686.
    - 4) W.R. Grace: Daracem 100, ADVA Cast 530, Mira 92, and ADVA Cast 575.
- D. Fly ash: Conform to ASTM C618. The use of a quality fly ash is required as a cement-reducing admixture (minimum 15 percent and maximum 25 percent). Fly ash used in concrete shall be from a single source and of a single class in combination with Portland cement of a single source and single class unless otherwise approved by the Engineer. The fly ash shall meet all of the requirements of ASTM C618, Class C or Class F, with the following special requirements: The loss on ignition in Table 1 shall not exceed 3 percent. Compliance to Table 1A shall apply. The amount retained on the 325 sieve in Table 2 shall not exceed 34 percent. Where a Type II low-alkali cement is specified, the total C<sub>3</sub>A shall be less than 8 percent of total cementitious material. The chemical analysis of the fly ash shall be reported in accordance with ASTM C311. Quality assurance testing and reports for a minimum of six months shall be submitted by the fly ash supplier.
- E. Certification: Certification of the above requirements is required from the admixture manufacturer prior to mix design review and approval by the Owner's Representative. Upon request by the Owner's Representative, a qualified representative is to be provided to assure proper use of admixtures. Use of admixtures, other than listed above will be permitted only when approved.
- F. Aggregates:

1. Normal-weight concrete - ASTM C33. For slabs, also conform to combined aggregate grading recommendations of ACI 302 and ACI 302.1R, unless otherwise permitted.
2. All concrete exposed to the weather shall conform to the limits of deleterious substances and physical properties of Table 3, ASTM C 33.
3. Local aggregates: Local aggregates not complying with ASTM C33, but which have been shown by special test or actual service to produce concrete of adequate strength and durability may be used when acceptable to the Owner's Representative.
4. The nominal size of an aggregate particle shall not exceed:
  - a. 20 percent of the narrowest dimension between sides of forms.
  - b. 33 percent of the depth of slabs.
  - c. 75 percent of the dimension between reinforcing bars.
  - d. 75 percent of the dimension between reinforcing bars and forms.
5. Maximum size of coarse aggregates and minimum cementitious contents: ACI 301 and ACI 302.1R.
6. Concrete aggregate alkali-silica reactivity (ASR) shall be tested in accordance with ASTM C1260 with a 14-day expansion (no supplementary cementing materials) or ASTM C1567 (with supplementary cementing materials) of less than 0.1 percent. Materials (cement, supplementary cementing materials, and aggregates) to be used in the concrete shall be tested. Coarse aggregates and fine aggregates shall be individually tested. If two grades of coarse aggregates are blended they shall be individually tested.

G. Water:

1. Clean, potable, and free of injurious amounts of oil, acid, alkali, organic or other deleterious matter not detrimental to concrete; drinkable.
2. Water shall contain no more than 650 parts per million of chlorides as Cl or more than 1000 parts per million of sulfates as SO<sub>4</sub>. In no case shall the water contain an amount of impurities that will cause a change in the setting time of Portland cement of neither more than 25 percent nor a reduction in compressive strength of mortar at 14 days of more than 5 percent when compared to the results obtained with distilled water when tested in accordance with ASTM C109.
3. Water used for curing shall not contain impurities in amounts to cause discoloration of the concrete or mortar or to produce etching of the surface.
4. Recycled water shall conform to ASTM C94.

## 2.3 GROUT/MORTARS

A. Cement grout: Conform to ASTM C387 "Dry packaged mixtures" or:

1. Mix at the site, in composition of one volume of Portland cement to 2-1/2 volumes of fine aggregate.
2. Mix the materials dry; then add sufficient water to make the mixture flow under its own weight.



3. Submittals: The following laboratory test results shall be submitted to show compliance with the requirements of this specification:
  - a. Initial setting time: 8 hours maximum
  - b. Vertical shrinkage: 0
  - c. Compressive strength: 4500 psi 1 day
  - d. Compressive strength: 8500 psi 7 days
  - e. Compressive strength: 10,000 psi 28 days
4. Field service: When required by the Owner's Representative, provide a qualified concrete technician employed by the Grout Manufacturer to assist in the initial grouting operations.
  - a. Euclid: NS Grout or Hi Flow Grout or E3 Grout series.
  - b. Sika: SikaGrout #212.
  - c. BASF: Masterflow 555 and Masterflow 928.

## **2.4 CURING**

- A. Dissipating liquid membrane-forming compounds for curing concrete; Conform to ASTM C309,  
Type 1. Curing compound shall be compatible with floor sealer or finish used. Low VOC.
  1. Euclid: VOX Kurex DR VOX series; waterborne products.
  2. W.R. Meadows: 1100-Clear series.
  3. Edoco: Burke Aqua Resin Cure.
  4. L&M Construction Chemicals: Cure R.
  5. BASF: Kure 200W
  6. Section 016000 - Product Requirements: Product options and substitutions. Substitutions: Permitted.

## **2.5 PROPORTIONING**

- A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. If laboratory trial batch method is used, use an independent testing facility acceptable to Owner's Representative for preparing and reporting proposed mix designs. The testing facility shall not be the same as used for field quality control testing and inspection unless otherwise acceptable to Owner's Representative.
- B. Submit written reports to the testing laboratory of each proposed mix for each class of concrete at least 15 days prior to start of work. Do not begin concrete production until mixes have been reviewed and approved. Include the following information for each concrete mix design:
  1. Method used to determine the proposed mix design.
  2. Gradation of fine and coarse aggregates, plus combined aggregate gradation for slabs, ACI 302.1R.

3. Aggregate specific gravities and absorptions.
  4. Proportions of all ingredients reported on a saturated surface dried basis including all admixtures added either at the time of batching or at the job site.
  5. Water-cementitious ratio.
  6. Slump, ASTM C143.
  7. Certification of the chloride content of individual admixtures and of the mixes as proposed.
  8. Air Content: ASTM C173 (Volumetric Method).
  9. Unit weight of concrete, ASTM C138.
  10. Strength at 3, 7, and 28 days, ASTM C39.
  11. Method of recording batch proportions.
  12. Substantiating test reports.
  13. Dosage of all admixtures, including synthetic reinforcement dosage in pounds per cubic yard.
- C. Concrete types and strengths: Minimum 28 Day Compressive Strength shall be per design requirements but not less than:
1. Paving base, columns, beams, walls, foundations, and footings: 4,000 psi.
  2. All concrete exposed to weather shall be air entrained (ASTM C260).
  3. All concrete shall be normal weight except as noted above.
  4. When the concrete mix design is developed from laboratory trial batching, adjust proportions to produce a design mix at least 1200 psi greater than the specified strength.
  5. When the field experience method is used, the required average compressive strength shall be determined in accordance with ACI 318. Documentation that proposed concrete proportions will produce an average compressive strength equal to or greater than the required average compressive strength shall consist of a field strength test record representing materials and proportions to be used for this project. A field strength test record shall consist of at least 10 consecutive tests encompassing a period of time of not less than 45 days and made within the past 12 months.
- D. Also, see general and specific notes on structural drawings.
- E. Weights: All concrete shall be normal-weight concrete unless otherwise designated on the structural drawings.
- F. Aggregate gradation: For slabs, also conform to combined aggregate grading recommendations of ACI 302.1R, unless otherwise permitted. For all other concrete not otherwise noted the coarse aggregate gradation shall conform to ASTM C33 size no. 57 or larger. Aggregate proportions for concrete containing synthetic fibers shall be approximately 50/50 coarse/fine aggregate for workability, adjusted as required in trial batches in accordance with ACI 211.1.
- G. Durability: Conform to ACI 301.

1. All concrete exposed to potentially destructive weathering, such as freezing and thawing, or to de-icer chemicals is to be air-entrained, 6 percent  $\pm 1$  percent, a minimum six sacks cementitious per cubic yard of concrete, 0.45 maximum water-cementitious ratio, and 4-inch maximum slump prior to the addition of water-reducing admixtures.
  2. Water-cement ratio: For concrete subject to freezing and thawing or deicer chemicals, the water-cement ratio shall not exceed 0.45 by weight including any water added to meet specified slump in accordance with the requirements of ASTM C94 unless otherwise noted.
- H. Slump: Conform to ACI 301.
1. 3 ½ inch maximum for consolidation by vibration
  2. 5 inch maximum for consolidation by other methods
  3. 8 inch maximum at point of discharge from truck into pump for pumped concrete containing synthetic fibers. Concrete containing HRWR admixture (super plasticizer): 3 inch maximum before addition of HRWR
  4. Where field conditions require slump to exceed that specified above, the increased slump shall be obtained by the use of a superplasticizer only, and the Contractor shall obtain written approval from the Owner's Representative who may require an adjustment to the mix.
- I. Production of concrete: Conform to ACI 301:
1. Cast-in-place concrete used in the work shall be produced at a single off-site batching plant or may be produced at an on-site batch plant.
  2. All concrete shall be proportioned conforming to the approved mix designs and of the materials contained in those approved mixes. A certified copy of the design weights for each mix shall be kept at the producing plant for each class of concrete used on the project.
  3. Plant equipment and facilities are to conform to the "Check List for Certification of Ready -Mixed Concrete Production Facilities" of the National Ready-Mixed Concrete Association (NRMCA) and have NRMCA or approved certification within the past year.
  4. Coarse aggregates shall be washed and, if necessary, shall be uniformly moistened just before batching. Each size of coarse aggregate shall be batched from separate bins as required to produce the combined grading requirements.
  5. Prior to adding a high-range water reducer (super plasticizer), slump shall not exceed the working limit. The high-range water reducing admixture shall be accurately measured and pressure-injected into the mixer as a single dose. If added at the jobsite, the field dispensing system shall conform to the same requirements as a plant system and tested prior to each day's operation. After the addition of the high-range water reducer, the concrete shall be mixed at mixing speed for a minimum of 5 minutes.
  6. Ready-mixed and on-site batched concrete shall be batched, mixed, and transported in accordance with ASTM C94.
    - a. Truck mixers and their operation shall ensure that the discharged concrete is uniformly within acceptable limits of consistency, mix, and grading. All

mechanical details of the mixer, such as water-measuring and discharge apparatus, conditions of the blades, speed of rotation, general mechanical condition of the unit, and clearance of the drum shall be checked before the use of the unit will be permitted.

- b. Truck mixers shall be equipped with approved revolution counters by which the number of revolutions of the drum or blades may readily be verified. The water tank system of the truck shall be equipped with gauges that permit accurate determination of the tank contents.
  - c. Each batch of concrete shall be mixed in a truck mixer for not less than 80 revolutions of the drum or blades and at the rate of rotation designated as mixing speed by the manufacturer of the equipment. Additional mixing, if any, shall be at the speed designated as the agitating speed by the manufacturer of the equipment. All materials, including mixing water but excluding any high-range water reducers added onsite, shall be in the mixer drum before actuating the revolution counter for determining the number of revolutions of mixing.
  - d. The concrete producer shall furnish duplicate delivery tickets, one for the Contractor and one given to the Owner's Representative for each batch of concrete. The information provided on the delivery ticket shall include the quantity of materials batched including the amount of free water in the aggregate and any water added onsite. Show the date, time of day batched, and if ready-mixed the time of discharge from the truck. The quantity of water that can be added at the site without exceeding the maximum water-cementitious ratio specified shall be noted on the delivery ticket.
- 7. Concrete produced by on-site volumetric batching and continuous mixing if approved shall conform to ASTM C685.
  - 8. The Engineer may increase the mixing time when the charging and mixing operations fail to produce a delivered batch in which variations of consistency, mix, or grading are within the limits specified.
  - 9. Variations in consistency during the discharge of a single batch shall not exceed 1 inch of slump, except that a greater variation will be permitted if the slump of the concrete decreases and no water is added. Variations in mix and in grading of different parts of the delivered batch shall be within limits stated in ASTM C94.
  - 10. Water shall be introduced prior to, during, and following mixer-charging operations.
  - 11. When a mixer produces unsatisfactory results, it shall be repaired promptly and effectively, or it shall be replaced.
  - 12. Mixers shall not be loaded in excess of their rated capacity.
  - 13. Overmixing, such as to require addition of water to preserve the required consistency or to reduce slump, will not be permitted.
  - 14. All other concrete: Conform to ACI 301
  - 15. Use of accelerating admixtures in cold weather and retarding admixtures in hot weather shall not relax placement requirements specified herein.
  - 16. All concrete placed at ambient temperatures below 50 degrees F is to contain an approved accelerator. The concrete temperature when delivered at the site shall be at least 50 degrees F.

17. All concrete placed at ambient temperatures above 80 degrees F is to contain an approved retarder.
18. All concrete required to be air-entrained is to contain an approved air-entraining admixture.
19. Fiber reinforcement shall be added to concrete during the batching or mixing process in accordance with manufacturer's instructions.
20. When improved workability, pumpability, lower water-cement ratio, or high ultimate and/or early strength is required, the HRWR admixture (super plasticizer) may be used.
21. Ensure air content for slabs with steel trowel finish is less than 3.0 percent.
22. The concrete shall be of such consistency and composition that it can be worked readily into the corners and angles of the forms and around reinforcement without permitting materials to segregate or free water to collect on the surfaces. Within the limiting requirements, adjust the consistency of the concrete as may be necessary to produce mixtures which will be placeable with reasonable methods of placing and compacting. Maintain on the job at all times adequate extra cement to be used at rate of 1/2 sack cement per cubic yard concrete for each 2" slump increase for corrections due to wetness desired or obtained. No water shall be added to concrete except under the direct awareness of the project inspector.
23. No water shall be added to concrete except under the direct awareness of the project inspector. The water-cementitious ratio stated on the approved mix designs shall not be exceeded unless approved by the Engineer. Re-tempered concrete shall be mixed for not less than 80 revolutions of the drum or blades and at the rate of rotation designated as mixing speed by the manufacturer of the equipment.
24. Adjustments to concrete mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant at no additional cost to Owner's Representative. Laboratory test data for revised mix design and strength results must be submitted and accepted before using in work.

## **2.6 FORMWORK**

- A. Section 031000 – Concrete Forming and Accessories

## **2.7 REINFORCING MATERIALS**

- A. Section 032000 – Concrete Reinforcement

## **2.8 MISCELLANEOUS MATERIALS**

- A. Dowel Bonding Material: Material for bonding reinforcement to the existing concrete:
  1. HY-200 adhesive as manufactured by Hilti Corporation.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Section 017300 – Execution: Verification of existing conditions before starting work.

- B. Verification of Conditions: Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive Work.
- C. Report in writing to Engineer prevailing conditions that will adversely affect satisfactory execution of the Work of this Section. Do not proceed with Work until unsatisfactory conditions have been corrected.
- D. By beginning Work, Contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to the United States Postal Service.

### **3.2 INSTALLATION – GENERAL**

- A. Install all cast-in-place concrete work in accordance with ACI 301 except as herein specified.
- B. Compact stone base aggregate to thickness indicated on drawings. Roll poof stone screenings topping to provide smooth hard surface on which to place slab. Surface should not show footprints or truck tracks when driven over
- C. Immediately before placing concrete, spaces to be occupied by concrete shall be free from standing water, ice, mud, and debris.
- D. Concrete shall not be deposited under water or where water in motion may injure the surface finish of the concrete.
- E. Immediately before placing concrete for exterior sidewalk, curb and gutter, pavements, and slab-on-grade, subbases and compacted subgrades shall be thoroughly moistened, but not muddied, by sprinkling with water. Surfaces shall be kept moist by frequent sprinkling, as required, up to the time of placing of concrete.
- F. Forms and the reinforcement shall be thoroughly cleaned of ice and other coatings. Remove surplus form releasing agent from the contact face of forms.
- G. Notify all trades concerned and the Owner's Representative sufficiently in advance of the scheduled time for concrete placement to permit installation of all required work by other trades.
- H. Before placing concrete, all required embedded items, including dovetail anchor slots, anchors, inserts, curb angles, metal frames, fixtures, sleeves, drains, stair nosings, accessory devices for Mechanical and Electrical installations shall be properly located, accurately positioned and built into the construction, and maintained securely in place.
- I. Build into construction all items furnished by the Owner and other trades. Provide all offsets, pockets, slabs, chases and recesses as job conditions require.
- J. Place and properly support reinforcing steel and anchor bolts.
- K. The alignment, orientation, spacing, and embedment length of mechanical load transfer devices in slab-on-grade and pavements shall conform to dimensions and tolerances shown on the drawings.

### **3.3 INSTALLATION – FORMWORK**

- A. Section 031000 – Concrete Forming and Accessories
- B. Construction and Contraction Joints: Conform to ACI 301 and recommendations of ACI 302.1R.

### **3.4 METHODS OF PLACEMENT AND PLACING CONCRETE**

- A. Placement: Conform to ACI 301:
  - 1. Maintain concrete cover around reinforcing as per Section 3.3 above and ACI 301.
  - 2. The methods and equipment used for transporting concrete to the site work and the time that elapses during transportation shall not cause segregation of coarse aggregate or slump loss in excess of 1 inch when measured at the point of discharge.
  - 3. Concrete shall be placed within 90 minutes after the water has been added to the cement and aggregates. Concrete shall be placed prior to initial concrete set.
  - 4. Placing of concrete will not be permitted during rainfall or when rain appears imminent. If rain should fall subsequent to placement, the concrete shall be completely protected until curing is complete.
  - 5. Cold-Weather Placement: Comply with provisions of ACI 306.1 “Standard Specifications for Cold-Weather Concreting” and as follows.
    - a. When air temperature has fallen to or is expected to fall below 40 deg F (4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.
    - b. When necessary, arrangements for heating, covering, insulating, or housing the concrete work shall be made in advance of placement and shall be adequate to maintain the required temperature during the first 24 hours.
    - c. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise accepted in mix designs.
    - d. Concrete shall not be placed on frozen ground or placed when the ambient temperature is 40 deg F or less and dropping.
    - e. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
    - f. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures using vented heaters and insulating blankets.
    - g. Vent heater exhaust gases that contain carbon dioxide outside of enclosed areas.
    - h. Concrete temperatures shall be maintained above 50 degrees F for the first 7 days of curing.

6. Hot-Weather Placement: When hot weather conditions exist that would impair quality and strength of concrete, place concrete complying with ACI 305R “Standard Specification for Hot-Weather Concreting” and as specified.
  - a. Cool ingredients before mixing to maintain concrete temperature at time of placement to below 90 deg F (32 deg C). Mixing water may be chilled or chopped ice of a size that will melt completely during mixing may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
  - b. Reject any concrete that has a temperature at the point of placement above 90 deg F, unless approved otherwise by the Construction Project Manager. When air temperatures are between 80 and 90 deg F the maximum mixing and delivery time is reduced to 75 minutes. When air temperatures exceed 90 deg F, the maximum mixing and delivery time is reduced to 60 minutes.
  - c. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedding in concrete.
  - d. Fog spray forms, reinforcing steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without puddles or dry areas.
  - e. Use water-reducing retarding admixture when required by high temperatures, low humidity, or other adverse placing conditions, as acceptable to Owner's Representative.
  - f. Spray evaporative retardants, wind breaks, misters, or shade concrete when the rate of surface evaporation when calculated in accordance with ACI 305.5 exceeds 0.2 lb/sq. foot per hour.

B. Depositing Concrete

1. Deposit concrete as near its final position as possible to avoid segregation due to rehandling or flowing. Hoppers, tremies, pump line, ducts, chutes, or other methods approved by the Engineer shall be used to deposit concrete in its final position within the specified time limits and without segregation of the mix.
2. The sequence of concrete placement and the number, type, position, and design of joints shall be approved by the Engineer prior to concrete placement.
3. Concrete shall be deposited as nearly as practical in its final position to avoid segregation due to re-handling or flowing. No concrete shall have a free fall of over three feet from truck, mixer, or buggies.
4. The concreting shall be carried on at such a rate that the concrete is plastic at all times and flows readily into the spaces between reinforcing bars. No concrete that has partially hardened or been contaminated by foreign materials shall be deposited in the work
5. When concreting is started, it shall be carried on as a continuous operation until the placing of the section is completed.
6. Except as intercepted by joints, concrete shall be placed in continuous layers. The depth of layers shall not exceed 20 inches. Succeeding layers shall be placed while the previous layer is still plastic. Concrete placement shall begin at the lowest point in each section of concrete to be placed.



7. Protect adjacent surfaces from concrete drippings, spillage, and splashes. Hardened or partially hardened splashes or accumulations of concrete on forms or reinforcement shall be removed before the work proceeds. Clean all damaged surfaces immediately.
8. All conveyances shall be thoroughly cleaned at frequent intervals during the placement of the concrete, and before the beginning a new run of concrete all hardened concrete and foreign materials shall be removed from the surfaces.
9. The Superintendent or Foreman in charge of concrete work shall mark on the drawings the time and date of the placing of each concrete pour. Locations where concrete test cylinders are made shall also be noted on the drawings. Such drawings shall be kept on file at the job until its completion and shall be subject to the inspection of the Owner's Representative at all times.

C. Conveyor Belts and Chutes

1. Chutes or conveyor belts shall not be used except as approved by the Engineer.
2. Concrete shall be conveyed from the mixer to the place of final deposit by methods that will prevent separation and loss of material.
3. Chutes longer than 50 feet and conveyor belts longer than 110 feet will not be permitted.
4. Equipment for conveying and chuting concrete shall be of such size and design as to insure a practically continuous flow of concrete at the delivery point without separation of material.
5. Provide runways or other means for wheeled equipment to convey concrete to point of deposit. Construct runways so that supports will not bear upon reinforcement or fresh concrete.
6. The minimum slope of chutes shall enable concrete of the specified consistency to readily flow.
7. Ends of chutes, hopper gates, and other points of concrete discharge throughout the conveying, hoisting, and placing system shall be designed and arranged so that concrete passing from them will not fall separated into whatever receptacle immediately receiving the concrete. Adequate headroom provision must be made at such points for a vertical drop and for proper baffling.
8. If a conveyor belt is used, it shall be wiped clean by a device operated so that none of the mortar adhering to the belt will be wasted.

D. Pumping of Concrete

1. The type and operation of a concrete pump shall be subject to the approval of the Engineer. The equipment used in placing the concrete and the method of its operation shall introduce the concrete into the forms without high velocity. Placing equipment shall be operated only by experienced operators.
2. During pumping, the Contractor shall have on-site a standby placing system, acceptable to the Engineer, to ensure that in the event of breakdown of the primary placing equipment, the concrete placement can continue without cold joints.
3. The minimum diameter of the hose or conduit shall be 4 inches unless otherwise approved by the engineer. Aluminum conduits shall not be used for conveying the

concrete. Pumping equipment, hoses, and conduits that are not functioning properly shall be replaced.

E. Joints

1. Joints shall be vertical in walls and horizontal in slabs.
2. Dowel bars and tie bars shall be inspected
3. If there is a delay in casting but prior to concrete initial set, the concrete placed after the delay shall be thoroughly spaded and consolidated at the edge of that previously placed to avoid cold joints. Concrete shall then be brought to correct level and struck off with a straight edge. Bullfroats shall be used to smooth slab surfaces, leaving it free of humps or hollows.
4. Where placing concrete is interrupted long enough for the concrete to take its initial set, the working face shall be made a construction joint.
  - a. Preparation and disposition of unplanned cold joints in walls shall be approved by the Engineer.
  - b. For slab-on-grade, pavements, sidewalk, and curb and gutter, concrete shall be removed back to the nearest planned joint and a construction joint installed.
5. Unless otherwise noted on the drawings, where concrete is to be placed against existing concrete, except in the case of expansion joints, the joint face of the existing concrete shall be roughened.
  - a. Before new concrete is placed against hardened concrete, the bonding surface of the existing concrete shall be roughened to an amplitude of 0.25 inch using bush hammers, abrasive blasting, or high-pressure water blasting.
  - b. The prepared surfaces of hardened concrete shall be kept thoroughly wet during the 24-hour period immediately prior to the placement of the new concrete. Wetting shall be accomplished by continuous sprinkling or by covering exposed surfaces with wet burlap.

F. Consolidation

1. All concrete shall be thoroughly consolidated by internal mechanical vibrators during the placing operation and shall be thoroughly worked around the reinforcement and embedded fixtures and into corners of the forms.
2. Concrete shall be consolidated by vibration to the maximum practicable density. The concrete shall be free from pockets of coarse aggregate and entrapped air.
3. Vibrators shall have a minimum diameter of 3 inches with a frequency of at least 7000 vibrations per minute and with an amplitude adequate to consolidate the concrete in the section being placed.
4. Forms shall contain sufficient windows or shall be limited in height to allow visual observation of the concrete during placement. Sufficient illumination shall be provided in the interior of forms so that at the places of concrete deposition the concrete shall be visible from the deck or runway.
5. Vibrators shall not be secured to forms or reinforcement.

6. Keep a minimum of two standby vibrators in operable condition on the job during concreting operations.
7. Consolidation shall be carried on continuously with the placing of concrete.
8. The number of vibrators employed shall be sufficient to consolidate the concrete within 15 minutes after it is deposited in the forms.
9. When consolidating each layer of concrete, the vibrator shall be operated at regular and frequent intervals 18 to 30 inches apart.
10. The vibrator shall be kept in nearly a vertical position as practicable. The use of vibrators to shift or drag concrete after deposition will not be permitted. Vibrators shall not be laid horizontally or laid over.
11. The vibrator head shall penetrate 6 to 8 inches into the preceding layer and then be withdrawn at a slow rate. The top part of each layer shall be re-vibrated systematically at the latest time the concrete can be made plastic by means of vibration.
12. Concrete shall not be placed until the previous layer has been vibrated.
13. Unless directed otherwise by the Engineer, the top 2 feet of walls shall be re-vibrated approximately 1 hour after placement of concrete and while a running vibrator will still sink under its own weight into the concrete and liquefy it momentarily.

G. Protection of cast concrete: Conform to ACI 301.

H. Repair of surface defects: ACI 301.

1. Inspect concrete surfaces and surfaces to be painted immediately upon removal of forms. Irregularities shall be immediately rubbed or ground to secure a smooth, uniform, and continuous surface.
2. Clean surfaces of tie holes. Tie holes shall be filled solid with patching mortar.
3. Surfaces to be smoothed shall not be plastered or coated.
4. Patch imperfections as needed or as directed by the Owner's Representative. Repairs in accordance with Section 3.8 shall not be made until the surface has been inspected and repair methods have been approved by the Owner's Representative.

### **3.5 FINISHING**

A. Finishing of formed surfaces: ACI 301:

1. Tops of forms:
  - a. Strike concrete smooth at tops of forms.
  - b. Float to texture comparable to formed surfaces.
2. Formed surfaces:
  - a. Finished formed surfaces shall conform accurately to the shape, alignment, grades, and sections shown on the drawings or prescribed by the Engineer.

- b. Surfaces shall be free from fins, bulges, ridges, honeycombing, or roughness of any kind and shall present a finished, smooth, continuous hard surface.
  - c. Permanently exposed surfaces: ACI 301 - "Smooth Form Finish" with the fins ground smooth and air holes shall be filled with a non-shrink mortar. The color of the patch material shall match the color of the surrounding concrete. Surfaces in unfinished areas unexposed to public view: ACI 301- "Rough Form Finish".
- 3. Concrete Finishes:
  - a. The following will not be permitted on finishes:
    - 1) Dusting dry cement or sand on the surface to absorb excess moisture.
    - 2) Use of a mortar finishing coat.
    - 3) Excessive troweling or manipulation that brings water or a large amount of fines to the surface.
    - 4) Addition of water to the surface during the finishing operation.
  - b. Surface preparation
    - 1) The concrete shall be brought up evenly to slightly above finished grade and shall be thoroughly compacted and consolidated. The top shall be struck off to accurately established grade strips or grade blocks. Complete screeding before any excess moisture or bleedwater is present on the surface.
    - 2) After bull floating, defer additional finishing operations until the concrete has stiffened sufficiently to sustain foot traffic pressure with an indentation of not more than 1/4 inch.
  - c. Exterior Concrete Finishes: Unless otherwise noted on the drawings, horizontal finishes shall be sloped a minimum 0.125 inch per foot to drain water. A light steel trowel with broom finish with bristles at 10 percent slope to the horizontal to score surface (not rip) unless otherwise noted on the plans.

### 3.6 CURING AND PROTECTION

#### A. Temperature, Wind, and Humidity

- 1. When concrete slabs and other unformed concrete is placed in warm, dry, dusty, or windy conditions, concrete surfaces shall be protected from rapid drying by use of windbreaks, shading, fogging with properly designed nozzles, or a combination of these measures. Hot weather concreting procedures provided in ACI 305R shall be used when ambient conditions dictate.
- 2. Cold weather concreting procedures provided in ACI 306R shall be used when ambient conditions dictate.
- 3. Changes in air temperature immediately adjacent to the concrete during and immediately following the 7-day initial curing period shall be kept as uniform as possible and shall not exceed 5 deg. F in any 1 hour or 50 deg. F. in any 24-hour time period.

## B. Curing Compound

1. All curing methods shall be placed immediately after final finishing (i.e., within two hours). Contractor's attention is directed to the fact that experience shows the most important time of curing is from three to four hours after placing and extending five to six hours thereafter. It is extremely important, therefore, to prevent loss of moisture, particularly during this period when concrete is especially vulnerable to plastic shrinkage cracks. All exposed surfaces of concrete including floor slabs, whether or not they receive a finish flooring, shall be protected from premature drying for a minimum of seven days.
2. Apply the specified curing compound in strict accordance with manufacturer's written instructions. Curing compound shall not be diluted by the addition of solvents or thinners, nor shall it be altered in any other manner. Curing compound that has become chilled and is too viscous for satisfactory application shall be heated by steam or hot water bath until it has proper fluidity. The temperature of the compound shall not exceed 100 °F. Curing compound shall not be heated by direct exposure of the container to fire.
3. When used on an unformed concrete surface, application of the first coat of curing compound shall commence immediately after finishing operations have been completed. When curing compound is used on a formed concrete surface, the surface shall first be moistened with a fine spray of water immediately after the forms have been removed. The spray shall be continued until the surface does not readily absorb further water. As soon as the surface film of water has disappeared and the surface is almost dry, the first coat of curing compound shall be applied. In the event that application is delayed on either formed or unformed surfaces, the surface shall be kept continuously moist until the compound has been applied or the specified period of water curing has elapsed.
4. Surfaces shall be sprayed uniformly with 2 coats of curing compound. Each coat shall provide a minimum coverage of 1 gallon per 250 square feet of surface. As soon as the first coat has become dry, a second coat shall be applied in the same manner. The direction of application of the second coat shall be perpendicular to the first coat. The curing compound shall be sprayed using approved pneumatic or pump driven equipment having the following characteristics:
  - a. Separate lines to the nozzle for material and for compressed air
  - b. A filtering system for the removal or entrapment of contaminants
  - c. A constant application pressure
5. Curing compound shall not be used on any concrete surface specified to receive additional concrete, coatings, grout, and chemical treatment

## C. Protection

1. Freshly placed concrete shall be protected against wash by rain.
2. Dust control shall be provided in the surrounding areas during placement. If, in the opinion of the Engineer, these conditions are not satisfactory met, concrete shall not be placed.
3. During the first 2-day period of curing, no traffic on or loading of the concrete will be permitted.

4. The contractor shall allow no traffic and take precautions to avoid damage to the membrane of the curing compound for a period of not less than 28 days. Damage shall be repaired immediately to the satisfaction of the Engineer.
5. Special care shall be taken to prevent avoid damaging the surfaces and joints due to load stresses from construction equipment, heavy shock, and excessive vibration. During construction activities, concrete shall be protected against damage with plywood or other approved materials until final acceptance by the Engineer.
6. Precautions shall be taken to prevent overloading floors, pavements, slabs, beams, and other members. The Contractor shall comply with the Engineer's instructions regarding the loads that will be permitted on these members during construction.
7. Self-supporting structures shall not be loaded in such a way to overstress the concrete.

### **3.7 PATCHING AND REPAIR**

- A. Concrete will be considered by the Engineer as not conforming to the intent of the drawings and specifications for the following reasons:
  1. Concrete this is not formed as shown on the drawings.
  2. Concrete this is not in true alignment or level.
  3. Concrete which exhibits a defective surface.
  4. Concrete with defects that reduce the structural integrity of a member or members.
  5. Concrete jointed slabs with uncontrolled random cracking.
- B. Non-conforming concrete to required thickness, lines, details, and elevations will be rejected by the Owner's Representative and shall be modified or replaced with concrete that conforms to the contract requirements without a claim by the Contractor for additional cost or extension of contract time.
- C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Owner's Representative for each individual area. Should the Owner's Representative grant permission for the Contractor to attempt restoration of a defective area by patching or other repair methods, such permission shall not be considered a waiver of the Owner's Representative's right to require complete removal of the defective area if, in the Engineer's opinion, the restoration does not provide the structural or aesthetic integrity of the member or members.
- D. All repairs of defective areas shall conform to ACI 301. On areas requiring treatment of defects and until such repairs have been completed, only water cure will be permitted
- E. At any time prior to final acceptance, concrete found to be defective, damaged, or not in accordance with the specifications shall be repaired or removed and replaced with acceptable concrete.
- F. If approved by the Owner's Representative, repair or replace concrete with excessive honeycombing due to improper placement.

1. Honeycombed areas shall be removed down to solid concrete a minimum of 1 inch over the entire area. Feathered edges will not be permitted. If chipping is necessary, the edges shall be perpendicular to the surface or slightly undercut.
  2. Laitance and soft material shall be removed prior to patching with a pea gravel concrete mix and bonding agent approved by the Engineer.
  3. The area to be patched and an area at least 6 inches wide surrounding it shall be dampened to prevent absorption of water from the patching materials.
  4. If a cement slurry bonding grout is approved, the heavy-cream consistency grout shall then be rigorously brushed into the surface. The concrete patch material shall be installed prior to the bonding grout skimming over or drying.
  5. If approved, a bonding admixture, bonding compound, or epoxy adhesive may be used in strict accordance with the manufacturer's preparation and application recommendations. Comply with ACI 301 and ACI 503.2 for standard specifications for bonding plastic concrete to hardened concrete with a multiple component epoxy adhesive.
  6. The repair concrete shall be thoroughly consolidated in place and struck off so as to leave the patch slightly higher than the surrounding surface. The concrete shall be left undisturbed for at least 1 hour to permit initial shrinkage then finished.
  7. The patched area shall be kept damp for 7 days.
  8. The color of the patch material shall match the color of the surrounding concrete. Repairs shall be made promptly while the base concrete is less than 28 days old.
  9. Metal tools shall not be used in finishing a patch in a formed wall that will be exposed.
- G. Areas requiring patching shall not exceed 2 sq. ft. per 1000 sq. ft. of surface area and shall be widely dispersed. Areas showing excessive defects as determined by the Engineer shall be removed and replaced.

### **3.8 GROUTING**

- A. After steel beams have been installed and leveled, grout the space between the bottom of the plate and concrete, using cement grout completely filling the space and forming solid bearing for the column base plate.

### **3.9 EVALUATION AND ACCEPTANCE OF CONCRETE**

- A. Comply with ACI 301 and modifications in this section.
- B. Compressive strength
1. Sets of standard-cured quality assurance cylinders will be taken by the Engineer during the progress of the work. The number of cylinder sets taken for each concrete mix design placed each day shall not be less than one set per day, nor less than one set for each 150 cu yds of concrete nor less than one set for each 5000 sq ft of surface area for slabs or walls.
  2. A set of cylinders consists of five cylinders cured in accordance with ASTM C31: one to be tested at 7 days and two to be tested and their strengths averaged at 28 days in accordance with ASTM C31. The fourth and fifth cylinders may be used

to test at other ages or to verify strength after 28 days in the event the 28-day strengths are low.

3. A 28-day compressive strength test shall consist of the average strength of at least two cylinders fabricated from a single load of concrete.
  4. The strength level of the concrete will be considered satisfactory so long as the averages of all sets of three consecutive strength tests equal or exceed the specified strength,  $f'_c$ , by more than 500 psi, not more than 10 percent of the tests are less than the specified 28-day strength, and no individual test is more than 500 psi below the 28-day specified strength.
  5. Should cylinder tests fail to meet the strength acceptance requirements or if deficient construction is suspected, core tests may be required and the costs of such tests paid by the Contractor. The Engineer shall identify core locations to least to impair the strength of the structure. Four-inch diameter cores shall be tested in accordance with ASTM C42.
  6. At least three representative cores shall be drilled from each member or area of concrete that is considered potentially deficient. If before testing, one or more cores shows evidence of having been damaged subsequent to or during the removal from the structure, it shall be replaced.
  7. Concrete in the area represented by core tests will be considered adequate if the average strength of the cores is equal to or at least 85 percent of and if no single core is less than 75 percent of the specified strength.
  8. Concrete that is deficient shall be isolated and retested to establish the boundary of deficient concrete. Concrete in the deficient area shall be removed and replaced.
  9. Core holes shall be repaired as directed by the Engineer.
- C. Air content will be determined in accordance with ASTM C231. The air content shall be taken with each set of test cylinders. If the air content is outside the specified range, the concrete shall be rejected. If concrete is to be air entrained for freeze-thaw durability, cores will be located to isolate deficient concrete by evaluating the air-void system in accordance with ASTM C457. Concrete in the deficient area shall be removed and replaced.
- D. Slump tests will be performed prior to placing the concrete. Such tests shall be made for each set of test cylinders defined for compressive strength. If the slump is outside the specified range, the concrete shall be rejected.
- E. The frequency of testing shall be increased if concrete fails to meet the acceptance criteria or if deemed by the Engineer to be too variable.

### **3.10 ACCEPTANCE OF STRUCTURE**

- A. Comply with ACI 301 and modifications in this section.
- B. Completed concrete work, which meets all applicable requirements, will be accepted without qualification.
- C. Completed concrete work which fails to meet one or more requirements but which has been repaired to bring it into compliance will be accepted without qualification.



- D. Completed concrete work which fails to meet one or more requirements and which cannot be brought into compliance may be accepted or rejected by the Owner's Representative. In this event, modifications may be required to assure that remaining work complies with the requirements.
- E. The costs of any additional tests or analysis, including additional architectural and engineering services, performed to prove the adequacy of the concrete work, shall be borne by the Contractor without extension of contract time.

### **3.11 MISCELLANEOUS CONCRETE**

- A. Equipment bases and foundations: Provide machine and equipment bases and foundations as shown on drawings. Set anchor bolts for machines and equipment with template at correct elevations, complying with certified diagrams or templates of manufacturer furnishing machines and equipment.

### **3.12 ADHESIVE ANCHOR INSTALLATION**

- A. Drilled-In Anchors and Dowels:
  - 1. Drill holes with rotary impact hammer drills using carbide-tipped bits or hollow drill bit system. Drill bits shall be of diameters as specified by the anchor manufacturer. Unless otherwise shown on the Drawings, all holes shall be drilled perpendicular to the concrete surface.
    - a. Embedded Items: Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Exercise care in coring or drilling to avoid damaging existing reinforcing or embedded items. Notify the Engineer if reinforcing steel or other embedded items are encountered during drilling. Take precautions as necessary to avoid damaging prestressing tendons, electrical and telecommunications conduit, and gas lines.
    - b. Base Material Strength: Unless otherwise specified, do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
  - 2. Perform anchor installation in accordance with manufacturer instructions.
  - 3. Cartridge Injection Adhesive Anchors: Clean all holes per manufacturer instructions to remove loose material and drilling dust prior to installation of adhesive. Inject adhesive into holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive. Follow manufacturer recommendations to ensure proper mixing of adhesive components. Sufficient adhesive shall be injected in the hole to ensure that the annular gap is filled to the surface. Remove excess adhesive from the surface. Shim anchors with suitable device to center the anchor in the hole. Do not disturb or load anchors before manufacturer specified cure time has elapsed.
  - 4. Observe manufacturer recommendations with respect to installation temperatures for cartridge injection adhesive anchors.
- B. Repair of Defective Work:

1. Remove and replace misplaced or malfunctioning anchors. Fill empty anchor holes and patch failed anchor locations with high-strength non-shrink, nonmetallic grout. Anchors that fail to meet proof load or installation torque requirements shall be regarded as malfunctioning.
- C. Field Quality Control:
1. Minimum anchor embedments, proof loads and torques shall be as shown on Drawings.
  2. Testing: 25% of each type and size of drilled-in anchor shall be proof loaded by the independent testing laboratory. Adhesive anchors and capsule anchors shall not be torque tested unless otherwise directed by the Engineer. If any of the tested anchors fail to achieve the specified torque or proof load within the limits as defined on the Drawings, all anchors of the same diameter and type as the failed anchor shall be tested, unless otherwise instructed by the Engineer.
    - a. Tension testing should be performed in accordance with ASTM E488.
    - b. Torque shall be applied with a calibrated torque wrench.
    - c. Proof loads shall be applied with a calibrated hydraulic ram. Displacement of adhesive anchors at proof load shall not exceed  $D/10$ , where  $D$  is the nominal anchor diameter.
  3. Minimum anchor embedments, proof loads and torques shall be as shown on Drawings.

### **3.13 FIELD QUALITY CONTROL**

- A. Section 014000 – Quality Requirements: Field testing and inspection.
- B. Requirements:
1. Provide and maintain an adequate program of quality control for the materials, production methods, and workmanship to assure conformance of all work to the project contract documents. ACI 121R outlines the essential elements of the Material Control portion of the QA program.
  2. All materials, equipment, and methods shall be subject to verification inspections and/or testing as specified herein; ACI 121R.
  3. Testing and Evaluation:
    - a. Furnish and pay for the services of an independent Testing Laboratory satisfactory to the Owner's Representative. The testing laboratory shall have prime responsibility for review, verification inspection, and testing of the concrete producer's materials, operations, facilities, and quality control procedures and evaluating the results for conformance with these specifications complying with ACI 121R.
    - b. The Testing Laboratory will be required to provide evidence of recent inspection of its facilities by the Cement and Concrete Reference Laboratory of the National Bureau of Standards (NBS) and to show that any deficiencies have been corrected.
    - c. In addition to the requirements and duties in ACI 301 the testing laboratory shall provide the following:

- 1) One or more additional test cylinders shall be taken during cold weather concrete placement and cured on the job site under conditions of concrete represented to determine safe form-stripping period.
- 2) Sample (and test when directed by the Owner's Representative) each shipment of cement and aggregates and verify approved admixtures. Store samples in a protected place until authorized to dispose of them.
- 3) Inspect concrete batching, mixing, and delivery operations periodically or as directed by the Owner's Representative.
- 4) Review manufacturer's reports and/or certification for each shipment of cement and reinforcing steel and/or conduct laboratory tests or spot checks of the materials as received for compliance with specifications.
- 5) Submit to the Owner's Representative and concrete producer, during construction, the results of concrete tests.
- 6) Include the following information:
  - a) Date of placement.
  - b) Structure and relative location.
  - c) The concrete mix design.
  - d) Unit weight of concrete - ASTM C138
  - e) Slump - ASTM C143
  - f) Air content of freshly-mixed concrete by the pressure method, ASTM C231 or the volumetric method, ASTM C173.
  - g) Concrete temperature (at placement time).
  - h) Air temperature (at placement time).
  - i) Strength determined in accordance with ASTM C39.
  - j) Other testing or inspection as required.
- d. The Testing Laboratory shall assess and report floor flatness and levelness in accordance with ASTM E1155.
- e. Field and concrete plant inspections are to be made by a competent representative of the Testing Laboratory during all structural concreting operations including periodic audit and spot check of the Producer's and/or Contractor's quality control procedures to assure proper and adequate control. When it appears that any material furnished fails to fulfill specification requirements, the Testing Laboratory is to report such deficiency immediately to the Owner's Representative and appropriately record it in his report.

## **END OF SECTION 033000**

## **SECTION 099100 – PAINTING & COATING**

### **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 DESCRIPTION OF WORK**

- A. Furnish all materials, labor, equipment and services necessary to perform painting and coating work.
- B. Work included in this Section includes painting and coating of all unfinished surfaces of equipment and materials provided under this contract and as noted, except for those items specifically noted herein as not requiring painting.
- C. Touch-up paint existing coatings damaged by construction.

#### **1.3 SUBMITTALS**

- A. Product Data Sheets
- B. Color charts
- C. Qualifications
- D. Field Test Reports

#### **1.4 QUALITY ASSURANCE**

- A. Painting contractor shall have a minimum of five (5) years continuous experience and shall maintain a qualified staff of painters for the duration of the work.
- B. Coatings shall be installed by contractors that have applied similar products at least twice in the last three (3) years.
  - 1. Verification of such experience shall be provided by the Contractor prior to proceeding.
- C. SSPC Standards:
  - 1. Comply with SSPC Painting Manual, Volumes 1 and 2, latest edition.
- D. Surface preparation and coating installation shall be in strict accordance with manufacturer's product data sheets, technical bulletins, and instructions.
- E. Comply with the temperature and humidity requirements for proper application and curing of the coatings.
  - 1. Provide temporary ventilation and/or heat if required for proper application and curing.

## **1.5 EXTRA MATERIALS**

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
  - 1. Quantity: Furnish an additional 5 percent, but not less than 1 gallon of each material and color applied.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- A. Material Compatibility:
  - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
- B. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- C. Colors: As selected by Owner's Representative from manufacturer's full range.
- D. Products specified herein are based on Sherwin-Williams products. Equivalent products by Tnemec or Porter are acceptable.

### **2.2 FILLING/FAIRING COMPOUND**

- A. A 100% solids, vertical surface, epoxy fairing compound, Sherwin-Williams Steel-Seam VSE, or approved equal.

### **2.3 COATINGS**

- A. Coatings shall be VOC compliant.
- B. Paint System Type A:
  - 1. Surface Preparation:
    - a. Solvent cleaning per SSPC-SP1.
    - b. Commercial blast cleaning per SSPC-SP6/NACE 3 to paint system manufacturer's recommended surface profile.
  - 2. Prime Coat: Polyamide epoxy, organic zinc-rich primer, Sherwin Williams Zinc Clad IV, with dry film thickness of 3.0 to 5.0 mils.
  - 3. Intermediate Coat: Surface tolerant, high solids, epoxy polyamide, 250 F dry heat resistance, Sherwin Williams Macropoxy 646, with dry film thickness of 3.0 to 10.0 mils.
  - 4. Finish Coat: Acrylic polyurethane, 250 F dry heat resistance, Sherwin Williams Acrolon 7300, with dry film thickness of 2.0 to 4.0 mils.
- C. Paint System Type B:
  - 1. Surface Preparation:

- a. Solvent cleaning per SSPC-SP1.
    - b. Hand tool clean to SSPC-SP2, or power tool clean to SSPS-SP3.
  2. Prime Coat: Surface tolerant, high solids, epoxy polyamide, 250 F dry heat resistance, Sherwin Williams Macropoxy 646, with dry film thickness of 5.0 to 10.0 mils.
  3. Finish Coat: Acrylic polyurethane, 250 F dry heat resistance, Sherwin Williams Acrolon 7300, with dry film thickness of 2.0 to 4.0 mils.
- D. Paint System Type C:
1. Surface Preparation:
    - a. Solvent cleaning per SSPC-SP1.
    - b. Commercial blast cleaning per SSPC-SP6/NACE 3 to paint system manufacturer's recommended surface profile.
  2. Prime Coat: Single component inert multipolymeric matrix coating, complying with NACE SP0198 CUI System CS-6 and SS-5, Sherwin Williams Heat-Flex Hi-Temp 1200 Coating Under Insulation, with dry film thickness of 5.0 to 6.0 mils.
  3. Finish Coat: Single component inert multipolymeric matrix coating, complying with NACE SP0198 CUI System CS-6 and SS-5, Sherwin Williams Heat-Flex Hi-Temp 1200 Coating Under Insulation, with dry film thickness of 5.0 to 6.0 mils.
- E. Paint System Type D:
1. Surface Preparation:
    - a. Detergent cleaning to remove surface contamination.
    - b. Lightly abrade the surface with fine grit sandpaper to dull surface.
  2. Adhesion Test: Spot test paint system for acceptable adhesion prior to proceeding. Consult paint manufacturer to address adhesion issues, as required.\_
  3. Prime Coat: Waterborne acrylic designed for coating hard, slick, glossy surfaces, Sherwin Williams Extreme Bond, with dry film thickness of 1.0 mil.
  4. Intermediate Coat: High performance acrylic, Sherwin Williams Sher-Cryl HPA, with dry film thickness of 2.0 to 3.0 mils.
  5. Finish Coat: High performance acrylic, Sherwin Williams Sher-Cryl HPA, with dry film thickness of 2.0 to 3.0 mils.
- F. Paint System Type E:
1. Surface Preparation:
    - a. Solvent cleaning per SSPC-SP1.
    - b. Brush blast cleaning per SSPC-SP16/NACE 3 to paint system manufacturer's recommended surface profile.
  2. Adhesion Test: Apply test patch. Allow paint to dry at least one week before testing adhesion. Demonstrate adhesion to satisfaction of Owner's Representative.
  3. Prime Coat: Sherwin Williams DTM Wash Primer, with dry film thickness of 3.0 to 5.0 mils.

4. Intermediate Coat: Alkyd, Sherwin Williams Industrial Enamel Alkyd Gloss Enamel, B54-100 Series, with dry film thickness of 1.9 to 3.0 mils.
5. Finish Coat: Alkyd enamel, Sherwin Williams Industrial Enamel Alkyd Gloss Enamel, B54-100 Series, with dry film thickness of 1.9 to 3.0 mils.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrate and confirm conditions are adequate for proper coating installation prior to proceeding.
- B. Address deficiencies prior to proceeding.

#### **3.2 COATINGS UNDER INSULATION**

- A. For coatings on surfaces to be insulated, field test and verify compatibility of coatings with insulation adhesives, mastics, caulks, etc. prior to proceeding.
  1. Coordinate field testing with insulation contractor as required.
  2. Proceed with coating application only if coating is confirmed acceptable by insulation contractor in writing.
  3. Advise Engineer of any issues in writing of any issues prior to proceeding.

#### **3.3 JOB CONDITIONS**

- A. Do not apply paint in snow, rain, fog, or mist; when the relative humidity exceeds 85 percent; at temperatures less than 5°F (3°C) above the dew point; to damp wet surfaces or in areas where dust is present.
- B. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50°F (10°C) and 90°F (32°C).
- C. Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45°F (7°C) and 95°F (35°C).
- D. Painting may be continued during inclement weather if areas and surfaces to be painted are enclosed and heated within temperature limits specified by paint manufacturer during application and drying periods.

#### **3.4 PREPARATION AND APPLICATION**

- A. Comply with manufacturer's written instructions and recommendations in "SSPC Painting Manual" applicable to substrates indicated.
- B. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
  1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.

- C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- D. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by the Owner's Representative and leave in an undamaged condition.
- E. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

### **3.5 SURFACE PREPARATION**

- A. Cover items which are not to be coated.
  - 1. Do not paint members, or portions of members, to be embedded in concrete or mortar.
    - a. Paint embedded steel which is partially exposed on exposed portions and initial 2" of embedded areas only.
  - 2. Do not paint surfaces which are to be welded or high-strength bolted with friction-type connections.
  - 3. Do not paint surfaces which are scheduled to receive sprayed-on fireproofing.
- B. Degrease surfaces with visual evidence of oily residue.
  - 1. Biodegradable, organic solvents, alkaline solutions, steam, hot water with detergents or other systems that will completely remove dirt, oil, grease, etc. may be used.
- C. Grind sharp edges to produce a smooth radius suitable for coating.
- D. Remove imperfections such as shipping brace welds, delaminations, scabs, slivers and slag prior to high-pressure washing.
- E. Prepare all surfaces for new paint systems in accordance with the manufacturer's instructions.

### **3.6 FILLING/FAIRING APPLICATION**

- A. Apply fairing compound to joints, grout plugs, and other surface irregularities to provide a smooth finish.
- B. The compound shall be applied in accordance with the manufacturer's instructions.

### **3.7 COATING APPLICATION**

- A. Stripe coat any surface discontinuities, crevices, or sharp edges, etc.
- B. Following stripe coat, apply a prime coat by brush, roller or spray to the dry film thickness indicated above.
- C. Following prime coat, apply intermediate and top coats by brush, roller or spray to the dry film thickness indicated above.



### **3.8 FIELD QUALITY CONTROL & TESTING**

- A. Coordinate Owner's Representative inspection of field surface preparations prior to field painting.
- B. Complete thickness testing and holiday, pinhole, and void detection of prime coat prior to proceeding with top coat.
- C. Complete thickness testing and holiday, pinhole, and void detection of top coat.
- D. All tests shall be done in the presence of the Owner's Representative and to his satisfaction.
- E. Any areas that the tests reveal are inadequately or improperly coated shall be repaired by the Contractor at his expense and in such a manner so as to have the same integrity as the properly applied coatings.

### **3.9 CLEANING**

- A. Contractor shall use temporary enclosures and other suitable methods as necessary to limit the amount of coating carrying over to other areas.
- B. During progress of work, remove from site discarded materials, rubbish, cans and rags at end of each work day.
- C. Remove temporary protective wrappings and clean any spattered surfaces.
- D. Upon completion of work, remove tools, materials, apparatus, and rubbish. Leave area clean, neat, and orderly.

### **3.10 DISPOSAL**

- A. Transport rubbish and materials off Owner's property and dispose of legally in accordance with Federal, State, and local laws and regulations.

### **3.11 FINAL TOUCH-UP**

- A. Prior to final completion of construction, clean and examine coating and repair any damage in accordance with manufacturer's instructions.

### **3.12 PAINT SCHEDULE**

- A. Surfaces to be Painted:

| <u>Surface Description</u>  | <u>System</u> | <u>Paint Color</u>  |
|---|---------------|---------------------|
| New Structural Steel Framing, Columns, Beams, Bracing, Platforms, Guard Rails | A             | Submit Color Charts |
| Existing Structural Steel Framing, Columns, Beams, Bracing                    | A             | Submit Color Charts |
| Supplemental Support Steel (Pipe & Electrical)                                | B             | Submit Color Charts |

Change in Scope, Re-Bid: Replace Emergency Generator, Infrastructure  
St. Louis Forensic Treatment Center - South, St. Louis, Missouri

M1908-01

|  |   |                     |
|--|---|---------------------|
| Carbon Steel Piping – No Insulation                      | B | Submit Color Charts |
| Carbon Steel Piping – Insulated                          | C | Submit Color Charts |
| Exterior PVC Piping                                      | D | Submit Color Charts |
| Galvanized Steel Conduit & Supports<br>(above roof only) | E | Submit Color Charts |

B. Surfaces Not to be Painted:

1. Galvanized surfaces (unless noted otherwise).

**END OF SECTION 099100**

## **SECTION 230501 – GENERAL MECHANICAL REQUIREMENTS FOR HVAC**

### **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 SCOPE**

- A. The requirements of this section are applicable to all work performed under Division 23 – Heating, Ventilating, and Air Conditioning (HVAC).

#### **1.3 COORDINATION**

- A. It is the intent of the Mechanical Division of these Specifications that all mechanical work specified herein be coordinated as required with the work of all other Divisions of the Specifications and Drawings so that all installations shall operate as designed.
- B. All systems shall be completely assembled, tested, adjusted and demonstrated to be ready for operation to the satisfaction of the Owner's Representative.
- C. The Contractor shall note that in some cases piping, ductwork and equipment as shown on the Drawings provide general location and routing information only. The Contractor shall be responsible for providing interference free systems with proper clearance to facilities and equipment.
- D. The Contractor shall note that configuration and dimensions of equipment may vary from that shown on the Drawings depending on the equipment supplied. The Contractor shall be responsible for making the necessary modifications to connecting piping, ducts, bases, etc. required by the equipment supplied.
- E. Where the word "provide" is used, it shall mean "furnish and install" unless otherwise noted or specified.

#### **1.4 SUBMITTALS**

- A. Submittals shall be furnished under this Division for approval in accordance with the procedures outlined in Division 1 and the separate sections of this Division.
- B. Submittals shall include complete data including physical dimensions and other information required for installation as well as performance capabilities and limitations. Provide schedules indicating locations when more than one type of an item is to be used. All shop drawings must be certified as being correct for the proposed work.
- C. Shop drawings, brochures or catalog cuts showing more than one size or model shall be marked to indicate the size or model proposed for the particular application.
- D. Prior to submitting for approval, submittals shall be coordinated with the work of all other trades.
- E. Submittals shall be identified as to the specific equipment for which the submittal relates. Identification shall be by reference to equipment numbers as shown on the Drawing or by

reference to the appropriate Article of the Specifications in which the equipment is specified.

## **1.5 INSTRUCTION MANUALS**

- A. Instruction manuals shall be furnished to Owner's Representative prior to start-up. Manuals shall be bound with table of contents and tabs for each section. Each set is to include the following information for all equipment furnished:
  - 1. Manufacturer's parts list identified with the make, model and serial number of the equipment furnished.
  - 2. Schematic control, flow and wiring diagrams identifying the location and function of all system components, valves and controls.
  - 3. Installation, operation, lubrication and maintenance instructions.
  - 4. Manuals shall incorporate design basis, drawings, flow diagrams, brochures and operating instruction in sufficient detail to enable operators to understand the equipment or system, its operation, limitations and maintenance needs.

## **1.6 CODES AND STANDARDS**

- A. Governing federal, state and local laws, codes and standards constitute minimum requirements and strict compliance therewith is required unless supplemented and/or modified by more stringent requirements of the Contract Documents.
- B. Installation of HVAC systems and equipment shall comply with all applicable codes. These shall include the latest edition of the following:
  - 1. International Mechanical Code
  - 2. International Plumbing Code
- C. All equipment, apparatus and systems shall be fabricated and installed in complete accordance with the latest edition or revision of the following applicable regulations, standards and codes:
  - 1. ANSI - American National Standards Institute
  - 2. ARI - Air Conditioning and Refrigeration Institute
  - 3. AABC - American Air Balance Council
  - 4. ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers
  - 5. ASME - American Society of Mechanical Engineers
  - 6. ASSE - American Society of Sanitary Engineering
  - 7. ASTM - American Society for Testing and Material
  - 8. AMCA - Air Moving and Conditioning Association
  - 9. AWS - American Welding Society
  - 10. BOCA - Building Officials and Code Administrators
  - 11. NFPA - National Fire Protection Association

12. IMC - International Mechanical Code
13. IPC - International Plumbing Code
14. NEC - National Electrical Code
15. NEMA - National Electric Manufacturers Association
16. NSF - National Sanitation Foundation
17. PDI - Plumbing and Drainage Institute
18. OSHA - Occupational Safety and Health Administration
19. SMACNA - Sheet Metal and Air Conditioning Contractors National Association
20. UL - Underwriters Laboratories, Inc.

## **1.7 QUALITY STANDARDS**

- A. All materials and equipment furnished under these Specifications shall be new and to the extent possible, standard products of the various manufacturers except where special construction or performance features are called for. Where more than one of the specific items is required, all shall be of the same type and manufacture.
- B. The product of manufacturers shall be acceptable only when that product complies with or is modified as necessary to comply with all specified and indicated requirements in the Contract Documents.
- C. Materials and equipment not herein specified or indicated as to manufacture but necessary for complete functioning systems shall be provided from sources conforming to the quality levels and functional requirements for corresponding materials and equipment set forth herein.

## **PART 2 - PRODUCTS**

### **2.1 NAMEPLATES**

- A. All equipment shall have factory applied permanent nameplates indicating the manufacturer's name, model and serial numbers, temperature and pressure design and any other data necessary to conform with specified requirements.

### **2.2 LIFTING ATTACHMENTS**

- A. All equipment requiring hoisting for installation and/or maintenance shall be provided with suitable lifting attachments by the manufacturer. Manufacturer's installation instructions shall detail correct lifting procedures to preclude equipment damage.

### **2.3 EQUIPMENT GUARDS**

- A. All rotating equipment including couplings, gear trains and belt drives shall be provided with adequate guards for personnel protection. Wherever possible, the guards shall be provided by the equipment manufacturer. The guards shall be supported to prevent vibration or interference with the rotating equipment and shall be removable. Guards shall conform to OSHA requirements.

## **2.4 EQUIPMENT PROTECTION**

- A. Equipment openings and connections shall be provided with adequate covers at the factory to protect the internals, threads and flanges and prevent entrance of any foreign matter prior to installation.
- B. Exposed machined surfaces of equipment such as shafts, bearing surfaces, gasket surfaces, gears, etc., shall be provided with adequate protection at the factory to prevent physical damage and corrosion prior to installation.

## **2.5 PAINTING AND FINISHES**

- A. All purchased equipment shall have a factory applied standard finish of the manufacturer's standard color unless otherwise specified.
- B. Finishes which are marred during shipping, handling or installation shall be touched up to match the original finish.
- C. Field fabricated bare iron or steel items required for installation of work under this Division shall have rough or sharp edges removed, be thoroughly cleaned of dirt, rust, weld slag, grease or oil.
- D. Comply with Division 09 requirements regarding paints and finishes.
  - 1. Small field-fabricated bare iron or steel items such as small pipe support members may be painted with one prime coat of rust inhibiting primer and one coat of epoxy polyamide, Sherwin William Zinc Clad IV and Macropoxy 646, or approved equal by Tnemec or Porter.

## **2.6 LUBRICATION AND TOOLS**

- A. Provide a fresh charge of lubricant in accordance with the manufacturer's recommendations to all equipment requiring lubrication prior to start-up and maintain lubrication as required until acceptance by the Owner.
- B. Provide for each piece of equipment any special tools and a list of such tools required for the operation or adjustment of the equipment and turn over to the Owner's Representative prior to final acceptance of the equipment.

## **2.7 GROUT**

- A. Unless otherwise required by the equipment manufacturer, grout shall be non-metallic, non-shrink type, with 5000 psi compressive strength at 28 days.

## **2.8 FIRE-RESISTANCE-RATED ASSEMBLY**

- A. Unless noted otherwise, provide UL 2 hour fire-resistant-rated penetrations through all walls and floors and ceilings.

## **PART 3 - EXECUTION**

### **3.1 WORK VERIFICATION AND FIELD MEASUREMENTS**

- A. All dimensions and clearances affecting the installation of work shall be verified in the field in relation to established datum, to building openings and to the work of other trades.
- B. Location of all equipment and systems shall be coordinated to preclude interferences with other construction.
- C. Should interferences occur which will necessitate deviations from layout or dimensions shown on the Drawings, the Owner's Representative shall be notified and any changes approved before proceeding with the work.

### **3.2 PERMITS AND INSPECTIONS**

- A. Contractor shall be responsible for obtaining the required permits governing the work from authorities having jurisdiction and shall assume the cost of permits and inspections.
- B. Upon completion of work, Contractor shall furnish to the Owner certificates of inspection or approval from the authorities having jurisdiction, if certificates of inspection or approval are required by law or regulations.

### **3.3 RECORD DRAWINGS**

- A. Contractor shall keep a written record of all deviations in location or elevation of piping and any underground or concealed installation from that shown on the Drawings. Records shall consist of clearly marked Drawings which shall be submitted to the Engineer after completion of construction.
- B. Underground utility services, both inside and outside of buildings, shall be dimensioned from permanent structures or benchmark. Utility services outside of buildings shall also show depth of burial or flow line with reference to the finished ground floor elevation.

### **3.4 ACCESSIBILITY**

- A. All work shall be installed so as to be accessible for operation, maintenance and repair with particular attention given to locating valves, controls and equipment requiring periodic lubrication, cleaning, adjusting or servicing of any kind.

### **3.5 FASTENING TO BUILDING STRUCTURES**

- A. The methods of attaching or fastening equipment or equipment supports or hangers to the building structure shall be subject to approval by the Owner's Representative at all times.
- B. Cutting, burning, drilling, welding or the use of explosive driven fasteners on building structures shall require prior approval by the Owner's Representative for each type of application unless specifically shown on the Drawings.
- C. Equipment or piping shall not be attached to or supported from the roof deck, from removable or knockout panels, or temporary walls or partitions unless specifically indicated on the Drawings.

### **3.6 THERMAL METAL JOINING AND CUTTING**

- A. All welding, brazing, soldering and cutting work shall conform to applicable provisions of the following codes and requirements:
  - 1. ASME Boiler and Pressure Vessel Code
  - 2. American National Standards Institute (ANSI) B31.1 (latest), Power Piping and Addenda
  - 3. American Welding Society (AWS) D1.1 (latest) Structural Welding Code
- B. Welding shall be performed only by skilled welders.
- C. Welders and welding procedures employed on pressure vessel or pressure piping work performed under the ASME/ANSI code shall be qualified in accordance with Section IX of the ASME Boiler and Pressure Vessel Code or with local codes where they take precedence. A record shall be maintained on the job showing the date and results of qualification test for each welder employed on the job for code welding. One certified copy of the qualification test for each welder so employed shall be furnished to the Owner.
- D. Welders and welding procedures employed on structural steel pipe and equipment supports shall be qualified by tests in the "Standard Qualification Procedure" of the AWS.
- E. A record shall be maintained on the job showing the date and results of qualification test for each welder employed on the job.
- F. Qualified weld procedures and one certified copy of the qualification test for each welder so employed shall be furnished to the Owner's Representative.
- G. Welding electrode storage shall, at a minimum, comply with the requirements of AWS D1.1, ANSI B31.9, ASME Boiler and Pressure Vessel Code, or the electrode manufacturer, whichever is most stringent.
- H. Contractor shall establish the proper quality control procedures and tests to ensure all welds shall comply with the applicable requirements of the codes referenced above.
- I. The Contractor shall test all pipe welds for proper quality using nondestructive, ultrasonic testing procedures.
  - 1. Testing shall be completed by Contractor's third party, certified weld inspector.
- J. Contractor shall complete any required repairs at Contractor's cost.
- K. Contractor shall complete any required repairs at Contractor's cost.
- L. All cutting residue shall be cleaned from the interior of pipes prior to welding or joining.

### **3.7 HOUSEKEEPING PADS AND ANCHOR BOLTS**

- A. Housekeeping pads shall be provided for all floor-mounted equipment. Unless otherwise shown, housekeeping pads shall be 4" high, 3000 psi concrete, with #4 reinforcing rods 12" on center each direction in center of pad.



- B. The size and configuration of housekeeping pads and anchor bolt requirements shall be coordinated with and shall be suitable for the equipment to be installed. Contractor shall be responsible for coordinating all requirements prior to forming and pouring the pad.
- C. Existing floor surface shall be roughened or epoxy binder applied prior to pouring pad. Pad shall be doweled to existing concrete with #4 reinforcing rods located 3" inside pad perimeter on 12" centers.
- D. Anchor bolts and sleeves shall be furnished for equipment provided under this Division to suit the equipment.

### **3.8 GROUTING**

- A. All mechanical equipment and pipe supports sitting on concrete shall be properly shimmed with stainless steel metal shims and grouted.
- B. Grout shall be placed to completely fill the area between the equipment and the concrete.
- C. Hollow equipment frames shall be completely filled with grout if recommended by the equipment manufacturer.

### **3.9 CUTTING AND PATCHING**

- A. All required openings shall be cut by the Contractor.
- B. Under no circumstances shall any structural members, loadbearing walls or footings be cut without first obtaining written permission from the Engineer and Owner's Representative.
- C. Cutting shall be in accordance with the following.
  - 1. Concrete or Masonry: All openings for pipe in concrete or masonry materials shall be core drilled. Square or rectangular openings shall be saw cut as necessary.
  - 2. Grating and Floor Plate: Openings in grating and steel floor plate shall be neatly cut without irregular edges.
  - 3. Roofing: All penetrations of roofing shall be made in strict accordance with manufacturer's recommended details so as not to void warranty.
- D. Patching shall be in accordance with the following.
  - 1. Concrete or Masonry: Install sleeves for piping penetrations in accordance with Section 232000. Patch the opening with grout finished smooth with adjacent surface.
  - 2. Grating: All openings cut in grating shall be banded.
- E. All below grade openings for pipe shall be sealed with interlocking synthetic rubber link assembly, Link-Seal by Thunderline Corporation or equal.

### **3.10 START-UP AND TESTS**

- A. The Contractor shall start-up the mechanical systems with his own personnel. Owner's personnel shall be in attendance.
- B. The Contractor's performance of the start-up shall not constitute acceptance. The Work shall remain the responsibility of the Contractor until final acceptance.

- C. Any equipment or system placed in temporary operation for testing or for the convenience of Contractor during construction and before Owner takes over operation shall be properly operated and maintained by Contractor.
- D. All equipment and systems shall be protected against freezing, flooding, corrosion or other form of damage prior to acceptance by the Owner.
- E. Material or equipment damaged, shown to be defective, or not in accordance with the Specifications, shall be repaired or replaced to the satisfaction of Owner's Representative.
- F. Before starting up any system, each piece of equipment comprising a part of the system, shall be checked for proper lubrication, drive rotation, belt tension, continuity of controls, and any other condition which may cause damage to equipment or endanger personnel.
- G. Contractor shall provide a competent service representative trained in starting up and servicing the respective equipment for which he is responsible. Service representative shall be present to supervise the start-up of equipment and/or systems and training the Owner's personnel.
- H. Test runs shall be made over the full design load range where possible, or simulated to the satisfaction of Owner's Representative for other conditions. Tests shall continue for as long as necessary to demonstrate that systems will operate as designed.
- I. During start-up all necessary adjustments shall be made, controls checked for proper operation, motors checked for possible overload, and the entire system checked by Contractor for any abnormal condition.
- J. During the start-up and prior to acceptance of any system, Owner's designated operating personnel shall be instructed in the operation and maintenance of the system.
- K. After start-up has been concluded and systems have been demonstrated to be satisfactory and ready for permanent operation, all permanent pipe line strainers and filters shall be cleaned, air filters cleaned or replaced, valve and pump packings properly adjusted, belt tensions adjusted, drive guards secured in place, lubrication checked and replenished if required. Temporary piping, ducting, wiring, instrument connections, etc., shall be removed, and openings restored in a permanent manner acceptable to Owner's Representative.
- L. All tests shall be made after notification to and in the presence of the Owner's Representative and the authorities having jurisdiction.

**END OF SECTION 230501**

## **SECTION 230505 – SELECTIVE DEMOLITION FOR HVAC**

### **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 DESCRIPTION OF WORK**

- A. Furnish all materials, labor, equipment and services necessary to perform all demolition work.
- B. Work included in this Section includes all demolition work as shown on the Drawings and as specified herein and as required to complete the Work.

#### **1.3 RELATED SECTIONS**

- A. Section 024119 – Selective Demolition
- B. Section 260505 – Selective Demolition for Electrical

#### **1.4 SUBMITTALS**

- A. Schedule of Selective Demolition Activities: Indicate detailed sequence of selective demolition and removal work, with starting and ending dates for each activity and interruption of utility services.
- B. Predemolition Photographs: Show existing conditions of adjoining construction and site improvements, including finished surfaces, which might be misconstrued as damage caused by selective demolition operations.
- C. Disposal Records: If hazardous wastes are removed by contractor, submit the following:
  - 1. Hazardous Waste Transporter license
  - 2. Permit or license for hazardous waste treatment or disposal facilities
  - 3. Completed Uniform Hazardous Waste Manifest for all shipments

#### **1.5 QUALITY ASSURANCE**

- A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.
- B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- C. Standards: Comply with ANSI A10.6 and NFPA 241, latest editions.
- D. Prior to beginning demolition, arrange a conference with the Owner's Representative to review demolition scope, procedures, schedule and items to be salvaged for the owner.

1. The Owner retains the right of first refusal on all items shown to be removed by the Contractor.

## **1.6 PROJECT CONDITIONS**

- A. Owner will occupy site and buildings immediately adjacent to selective demolition areas. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Owner's Representative of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
  1. Maintain fire-protection and life safety facilities in service during selective demolition operations.

## **1.7 WARRANTY**

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

## **1.8 MATERIALS OWNERSHIP**

- A. Except for items or materials to be reused, salvaged, reinstalled or otherwise indicated to remain the Owner's property, demolished materials shall become the Contractor's property and shall be removed from the site with further disposition at the Contractor's option but in compliance with ordinances and regulations related to the materials being disposed.

## **PART 2 - PRODUCTS (NOT USED)**

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION & RECORDING OF CONDITIONS**

- A. Verify that utilities have been disconnected and capped.
- B. Survey existing conditions and coordinate and identify the extent of the demolition work required. Record existing conditions using preconstruction photographs.
- C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged. Use photographs to document conditions.
- D. When unanticipated site, mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Owner's Representative and Engineer.
- E. Engage a professional engineer to survey conditions of existing structures to determine whether excavations or the removal of any element might result in structural deficiency or

unplanned collapse of any portion of existing structures during selective demolition operations.

- F. Perform surveys as the work progresses to detect hazards resulting from the execution of the work.

### **3.2 COORDINATION**

- A. No demolition work shall be performed without prior approval of the Owner's Representative.
- B. Demolition work shall be carried on in a manner so as not to interfere with operation of the Owner's facilities.
- C. Any demolition work which interferes with Owner's operation shall be scheduled with the Owner's Representative and be subject to the Owner's approval.
- D. Maintain existing services required to avert disruption to the Owner's on-going operations and protect them against damage during the performance of the work.
- E. Do not interrupt existing utilities serving occupied facilities except when authorized in writing by the Owner and authorities having jurisdiction.
- F. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and to authorities having jurisdiction.
- G. Unless noted otherwise, provide not less than two weeks' notice to the Owner if shutdown of service is required during the execution of the work.
- H. The Contractor shall not remove any material beyond the limits indicated on the Drawings unless given permission to do so by the Owner's Representative. Any such material removed shall be replaced by the Contractor at his expense. If the items removed are damaged and/or cannot be satisfactorily reinstalled, new material of like construction shall be furnished and installed by the Contractor at his expense.
- I. All damages to buildings and utilities to remain in place shall be promptly repaired at no cost to the Owner. Repairs and restoration of accidental utility interruptions shall be made before the workmen responsible for the repair and restoration leave the job on the day such interruptions occur.

### **3.3 PREPARATION**

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
- C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

- D. Existing building openings may be used to remove material. No new openings may be made without approval of the Owner's Representative.

### **3.4 PROTECTION**

- A. Comply with governing laws, codes, and regulations governing fire protection and environmental protection during demolition operations.
- B. Comply with the International Fire Code including the requirements for fire safety during demolition and construction and for welding and other hot work.
  - 1. Maintain a hot work program permit system, including fire watch.
  - 2. Maintain portable fire-suppression devices in work areas.
  - 3. Minimize hot work within occupied buildings.
- C. Provide dust control and ventilation as required in areas of demolition.
- D. Execute demolition work, so as to insure adjacent areas against damage which might occur from falling debris or other causes; do not interfere with the use of, operations in, or around adjacent areas; maintain free and safe passage of persons around the areas of demolition.
- E. Provide temporary handrail, barricades, floor plates, etc. as required to provide protection for open elevated platforms, holes, etc. created by the demolition work.
- F. Premises shall be maintained and protected from all unsafe or hazardous conditions at all times.
- G. Protect existing surfaces, active utility services, and equipment which are to remain in place.
- H. No blasting will be permitted.

### **3.5 DUST CONTROL**

- A. Contractor shall use temporary enclosures and other suitable methods as necessary to limit the amount of dust and dirt carrying over to other parts of the Owner's property.
- B. Adequacy of the dust control methods shall be subject to the approval of the Owner's Representative.
- C. Areas of major demolition inside the Owner's property shall be enclosed by means of temporary walls constructed of wood framing with plywood or 6 mil polyethylene sheets.
- D. Temporary enclosures shall be removed by the Contractor upon completion of the demolition work unless otherwise directed by the Owner's Representative.

### **3.6 DEMOLITION - GENERAL**

- A. Remove all work indicated on the drawings and as required to complete the new work indicated.
- B. During demolition operations, keep areas adjacent to demolition work free of dust and debris.

- C. During demolition operations, if suspected hazardous materials or conditions are uncovered, stop work in that area, and inform the Owner's Representative.
- D. At concealed spaces, such as hollow walls, ducts, and pipe interiors, verify condition and contents of hidden space before starting demolition operations.
- E. Neatly cut openings and holes plumb, square and true to dimensions, required.
- F. Use cutting methods least likely to damage construction to remain or adjoining construction.
- G. To minimize disturbance of adjacent surfaces, use hand or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
- H. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
- I. Do not use cutting torches until work area is cleared of flammable materials.
- J. Maintain portable fire-suppression devices in the area during flame-cutting operations.
- K. Contractor shall take care when using a torch to cut steel welded or bolted to structural members so as to cut flush with but not damage the structural members.
- L. All hanger and support material for demolished piping and conduit shall be removed back to the primary structural support member. Grind connection to primary member smooth and touch up with paint to match adjacent surface.
- M. All elevated equipment and materials to be demolished shall be carefully lowered (not dropped) by means of temporary riggings. Contractor shall not overload any elements of existing structure during the rigging operation.
- N. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
- O. Dispose of demolished items and materials promptly.

### **3.7 CONCRETE AND MASONRY DEMOLITION**

- A. Demolish concrete and masonry in small sections.
- B. Cut concrete and masonry at junctures with construction to remain, using power driven masonry saw or hand tools. Do not use power-driven impact tools.
- C. Sidewalks, curbs, gutters and pavement shall be neatly saw cut at existing joints where removal is required for new construction.

### **3.8 PIPING DEMOLITION**

- A. The Contractor shall use caution in the demolition of piping and shall inform himself of the conditions (fluid, pressure, temperature) of all piping systems to be demolished before making any cuts or breaking any joints.
- B. Prior to breaking or cutting piping or tubing within the demolition area, the Contractor shall ascertain that the system has been marked in the field or shown on the Drawings to be removed

under this contract. Contact Owner's Representative for clarification prior to demolishing or removing questionable items.

- C. Arrange for shutoff, isolation, and lock-out of piping with Owner's Representative or utility companies.
- D. When indicated on the drawings, before proceeding with selective demolition, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems.
- E. All remaining piping with open ends resulting from demolition work shall be promptly capped, plugged or blind flanged.

### **3.9 ELECTRICAL DEMOLITION**

- A. See Section 260505 – Selective Demolition for Electrical in these Specifications.

### **3.10 PATCHING**

- A. All holes or openings in floors, walls or ceilings resulting from demolition shall be properly sealed with material similar to the adjacent surface/finish.
- B. All rough edges of openings created by demolition shall be promptly patched to create a finished surface.
- C. Openings in concrete shall be patched with cement mortar.
- D. Openings in masonry shall be patched by toothing in masonry units to match existing.

### **3.11 REMOVED AND SALVAGED ITEMS**

- A. Carefully remove and clean salvaged items.
- B. Pack or crate items after cleaning. Identify contents of containers.
- C. Store items in a secure area until delivery to Owner.
- D. Transport items to Owner's storage area as directed by Owner's Representative.
- E. Protect items from damage during transport and storage.
- F. The existing diesel-engine-driven generator set, including weatherproof enclosure, access stairs and platform, structural steel base rails and all items within the generator set weatherproof enclosure are to be salvaged after removal, cleaned and crated as indicated above, and loaded onto a trailer to be provided by the Owner at the project site.

### **3.12 REMOVED AND REINSTALLED ITEMS**

- A. Carefully remove items to be reinstalled.
- B. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
- C. Pack or crate items after cleaning and repairing. Identify contents of containers.



- D. Protect items from damage during transport and storage.
- E. Reinstall items in locations indicated.
- F. Comply with installation requirements for new materials and equipment.
- G. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- H. If the items removed are damaged and/or cannot be satisfactorily reinstalled, new material of like construction shall be furnished and installed by the Contractor at his expense.

### **3.13 EXISTING ITEMS TO REMAIN**

- A. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition.
- B. When permitted by Owner's Representative, items may be removed to a suitable, protected storage location during selective demolition and reinstalled in their original locations after selective demolition operations are complete.

### **3.14 DISPOSAL**

- A. All debris resulting from demolition operations shall become the property of the Contractor and shall be removed daily from the Owner's property unless otherwise permitted by the Owner's Representative.
- B. Storage of removed materials on site will not be permitted.
- C. Sale of removed materials on-site will not be permitted.
- D. Transport demolished materials off Owner's property and dispose of legally in accordance with Federal, State, and local laws and regulations.
- E. Upon completion of work, remove tools, materials, apparatus, and rubbish. Leave area clean, neat, and orderly.

### **3.15 CLEANING**

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations.
- B. Return adjacent areas to condition existing before selective demolition operations began.

### **3.16 HAZARDOUS MATERIALS**

- A. The Owner, to the best of his knowledge, does not believe that hazardous materials containing friable asbestos are included in the items to be demolished or the work areas.
- B. Inspect all instruments, controls, and lights to be removed for mercury. Dispose of mercury containing materials in accordance with applicable standards.
- C. Should the Contractor discover additional material in the work area which is suspected to contain hazardous materials, do not disturb.

- D. Contact and consult with the Owner's Representative prior to proceeding. The Owner's Representative shall direct the Contractor how to proceed.

**END OF SECTION 230505**

## **SECTION 230523 – GENERAL DUTY VALVES FOR HVAC PIPING**

### **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 SCOPE**

- A. The Contractor shall furnish and install all manual valves as shown on the Drawings and specified herein.

#### **1.3 SUBMITTALS**

- A. Submit manufacturer's data sheet for each type valve. Data sheets shall be marked with the valve code noted herein (BA-1, etc.) for purposes of identification.

### **PART 2 - PRODUCTS**

#### **2.1 GENERAL**

- A. All valves shall comply with ASME 16.5, ASME B16.10, ASME 16.25, ASME B16.34, MSS-SP-45, MSS-SP-61, MSS-SP-84.
- B. Valves shall provide shutoff per MSS-SP61 over a range of differential pressures up to the maximum pressure rating coincident with the operating temperature over a range up to the maximum temperature rating of the valves.
- C. All valve stems shall be blowout proof.
- D. Provide to Owner's Representative two operating wrenches for each type valve not equipped with handwheels or levers.
- E. Provide suitable manual actuator for valves with unacceptably high operating torque due to service, size and style of valves.
- F. All valves located 7' or more above floor, walkways or platforms, etc., shall be furnished with manufacturer's standard chainwheel operators, with chains extending to 5' above the operating level.
- G. All valves shall have suitable devices for accepting padlock for locking the valve closed or open. When available, the valve manufacturer's standard locking arrangement shall be utilized.
- H. Provide spare lubricant stick with each lubricated plug valve. Lubricant to be compatible with service requirements.
- I. Packing shall be suitable for the intended service.
- J. Bore on butt weld valves shall match mating pipe.
- K. Ship valves completely assembled with end covers.

Change in Scope, Re-Bid: Replace Emergency Generator, Infrastructure  
St. Louis Forensic Treatment Center - South, St. Louis, Missouri

M1908-01

## 2.2 MANUFACTURERS

- A. Valve manufacturer is listed for purposes of clarification. Equivalent valves produced by an approved manufacturer may be used.

## 2.3 VALVES

- A. Gate Valves – Socket Weld:

| <u>TYPE</u> | <u>SIZE</u>     | ANSI<br>PRESSURE_<br><u>CLASS</u> | <u>DESCRIPTION</u>  | MANUFACTURER'S<br><u>NUMBER</u> |
|-------------|-----------------|-----------------------------------|---|---------------------------------|
| GA-1        | 2" and<br>under | 800                               | Socket Weld<br>Forged Steel A105<br>OS&Y<br>13% Cr Trim<br>Graphite Packing | Hancock 950 W<br>Vogt SW 12111  |

- B. Check Valves – Socket Weld :

| <u>TYPE</u> | <u>SIZE</u>     | ANSI<br>PRESSURE<br><u>CLASS</u> | <u>DESCRIPTION</u>   | MANUFACTURER'S<br><u>NUMBER</u> |
|-------------|-----------------|----------------------------------|--|---------------------------------|
| CK-1        | 2" and<br>under | 800                              | Socket Weld<br>Forged Steel A105<br>Swing Check<br>Horizontal/Vertical<br>Upward Flow Type<br>13% Cr Disc<br>316 HF Seat | Vogt SW 701                     |

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. If space permits, install valves with stems extending vertically upward or within 60° of vertical unless specifically shown otherwise.
- B. All valves shall be installed in accessible locations for operation as well as for removal, repair or replacement.
- C. Proved manufacturer's recommended upstream and downstream straight run piping at balance valves and triple duty valves.

**END OF SECTION 230523**

# SECTION 230529 – HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

## 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 SCOPE

- A. The Contractor shall furnish and install all pipe hangers and supports required for the HVAC piping and equipment systems.

### 1.3 SUBMITTALS

- A. Product data sheets for expansion bolts, adhesive anchors, dielectric materials, and spring hangers.
- B. Shop drawings for pipe support structural steel.

## PART 2 - PRODUCTS

### 2.1 PIPE SUPPORT COATINGS

- A. All pipe support materials located outdoors shall be galvanized.

### 2.2 MANUFACTURERS

- A. Manufacturer's figure numbers indicated herein or shown on the Drawings are Anvil and are for clarification purposes.
- B. Equivalent material by Basic Engineers, Inc. or Bergen-Paterson may be used.

### 2.3 HANGER RODS

- A. Hanger rods shall be electro-galvanized machine threaded rods (Fig. 140, 253) ASTM A36 or ASTM A575 with threads conforming to ANSI B1.1.
- B. Minimum rod size shall be as follows

| <u>Pipe Size</u> | <u>Hanger Rod Diameter</u> |
|------------------|----------------------------|
| 2" and under     | 3/8"                       |
| 2-1/2", 3"       | 1/2"                       |
| 4"               | 5/8"                       |
| 6"               | 3/4"                       |
| 8" thru 12"      | 7/8"                       |
| 14" thru 18"     | 1"                         |
| 20" thru 24"     | 1-1/4"                     |

## 2.4 SADDLES AND SHIELDS

- A. Hot, insulated, horizontal piping shall have pipe covering protection saddles (Fig. 160-166A) at all support points.
- B. Saddle depth shall be equal to or slightly greater than insulation thickness.
- C. Cold, insulated, horizontal piping shall have galvanized insulation protection shields (Fig. 167) at all support points.

## 2.5 HANGERS

- A. Unless otherwise shown or specified, hangers for horizontal piping shall be as follows:
  - 1. Uninsulated pipe: Adjustable clevis, (Fig. 260).
  - 2. Insulated Pipe – Hot (200°F or less): Adjustable clevis, (Fig. 260).
  - 3. Insulated Pipe - Hot (212°F and above):
    - a. 2-1/2" and under: Adjustable clevis, (Fig. 260)
    - b. 3" and above: Adjustable steel yoke pipe roll, (Fig. 181)
  - 4. Insulated Pipe - Cold: Adjustable clevis, (Fig. 260)
  - 5. Copper Pipe: Adjustable tubing ring, plastic coated (Fig. CT-99C)
  - 6. Plate Lugs: Forged steel clevis, (Anvil Fig. 299 or equal)
- B. Unless otherwise shown or specified hangers for vertical piping shall be riser clamps (Fig. 261) installed below hubs, or lugs welded to the pipe or clevis with a plate lug welded to elbow at top of riser.

## 2.6 UPPER ATTACHMENTS

- A. Unless otherwise shown or specified upper attachments shall be as follows:
  - 1. 2" and under (optional): C-clamp with locknut (Fig. 86)
  - 2. 4" and under: Malleable beam clamp with extension piece (Fig. 229) or welded beam attachment (Fig. 66) with bolt and weldless eye nut (Fig. 290).
  - 3. 8" and above: Beam clamp with weldless eye nut (Fig. 292) or welded beam attachment (Fig. 66) with bolt and weldless eye nut (Fig. 290).
- B. Unless otherwise shown or specified upper attachments for structural concrete ceilings shall be as follows:
  - 1. Concrete single lug plate (Anvil Fig. 47 or equal) or clevis plate (Anvil Fig. 49 or equal). Expansion anchors shall be stainless steel.
  - 2. For pipe 3" and under (optional): Carbon steel, drop-in type female expansion anchor.
- C. Provide medium welded steel brackets (Fig. 195) for small bore pipe (2" or less) supported from concrete or masonry walls, if shown on Drawings.
- D. Piping 2-1/2" and smaller may be supported eccentrically (9" maximum) with 3 x 3 x 1/4" angles welded to columns or beams which are at least 8" deep.

- E. Not more than one eccentric attachment per beam will be permitted.

## **2.7 COPPER PIPE**

- A. Unless shown otherwise in the Drawings, copper piping shall be supported as follows:
  - 1. Copper finished extension split tubing clamp (Anvil Fig. CT-138R or approved equal).
  - 2. Copper plated adjustable clevis (Anvil Fig. CT-65 or approved equal).
- B. Copper pipe shall be isolated from steel pipe support members with minimum 1/8" thick rubber sheet.

## **2.8 U-BOLTS**

- A. U-bolts for steel pipe shall be carbon steel furnished with four hex nuts and two jam nuts. (Anvil Fig. 137 or approved equal).
- B. U-bolts for copper pipe shall be plastic coated carbon steel with hex nuts. (Anvil Fig. 137C or approved equal).

## **2.9 TUBE SUPPORT**

- A. Tubing for instrumentation and controls shall be supported with James C. White Company, Inc., "Tubetrack" or equal.

## **2.10 PIPE STANCHIONS**

- A. Pipe stanchions shall be Fig. 63 or field fabricated equal from Schedule 40 pipe and 3/8" thick base plate.
- B. Stanchion size shall be half the size of the pipe being supported but not less than 2" diameter.
- C. Stanchion base plate shall not sit directly on floor but shall have minimum 1" non-metallic, non-shrink grout underneath.
- D. Bolt base plate to floor with stainless steel expansion anchors.

## **2.11 PIPE SUPPORT STRUCTURAL STEEL**

- A. Wide flange beams shall be ASTM A992 (50 ksi minimum yield stress).
- B. Miscellaneous structural steel, plates, etc. for pipe supports and anchors in trenches and manholes shall be ASTM A36 (36 ksi minimum yield stress) of sizes and shapes as shown on the Drawings.
- C. Structural tubing shall be ASTM A500, Grade B (46 ksi minimum yield stress).
- D. Welding of structural steel supports and anchors shall be completed with E70XX electrodes.

## 2.12 EXPANSION BOLTS

- A. Expansion bolts and nuts used in connection with pipe support structures shall be stainless steel, Hilti “Kwik Bolt III” or approved equal by Powers or Red Head.
- B. Embedment shall be as follows, unless noted otherwise:

| <u>Bolt Diameter, in.</u> | <u>Embedment, in.</u> |
|---------------------------|-----------------------|
| 1/2                       | 3-1/2                 |
| 5/8                       | 4                     |
| 3/4                       | 4-3/4                 |
| 1                         | 6                     |

## 2.13 ADHESIVE ANCHORS

- A. Anchors for fastening to concrete shall be adhesive type consisting of a two-part resin adhesive contained in a cartridge and 304SS anchor bolts with washer and nut, Hilti HIT HY200 with HIT-Z-R anchor bolt with minimum 6” embedment, or approved equal by Powers or Red Head.
- B. Anchors for fastening to masonry shall be adhesive type consisting of a two-part resin adhesive contained in a cartridge, 304SS screen tube (for hollow construction) and 304SS thread rod with washer and nut, Hilti HIT HY20 or approved equal by Powers or Red Head.
  - 1. Pipe supports from masonry shall be installed only after review and approval by the Engineer.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. All piping shall be supported by suitable hangers to prevent excessive stress, swaying, sagging, or vibration.
- B. Piping shall not be so restrained, however, as to cause it to snake or buckle between supports or anchors or to prevent movement due to expansion and contraction.
- C. Hangers and supports shall be complete, including lock nuts, clamps, rods, bolts, couplings, swivels, inserts, required accessory items and secondary structural steel members.
- D. Pipes shall be supported individually unless shown otherwise on drawings.
- E. Provide supports, where pipe changes direction and at equipment connections.
- F. Provide at least one hanger adjacent to each joint with mechanical couplings.
- G. Weld pipe saddles to pipe.
- H. Provide supplemental pipe support structural steel suitable for the applied loads as necessary to properly support all pipe.



### 3.2 SPACING

- A. Unless otherwise shown on the Drawings the maximum spacing of supports for horizontal piping shall be as follows:

| <u>Steel Pipe:</u> | <u>Maximum Spacing, ft.</u> |                        |
|--------------------|-----------------------------|------------------------|
|                    | <u>Steam, Liquids</u>       | <u>Air &amp; Gases</u> |
| 1/2"               | 5                           | 6                      |
| 3/4"               | 6                           | 8                      |
| 1"                 | 7                           | 9                      |
| 1-1/4"             | 8                           | 10                     |
| 1-1/2"             | 9                           | 11                     |
| 2"                 | 10                          | 13                     |
| 2-1/2"             | 11                          | 14                     |
| 3"                 | 12                          | 15                     |
| 4"                 | 14                          | 17                     |
| 6"                 | 17                          | 21                     |
| 8"                 | 19                          | 24                     |
| 10"                | 21                          | 27                     |
| 12"                | 23                          | 30                     |
| 16"                | 27                          |                        |
| 18"                | 34                          |                        |
| 24"                | 40                          |                        |

Copper tubing:

|                |    |
|----------------|----|
| 1" and under   | 5  |
| 1-1/4", 1-1/2" | 7  |
| 2" and above   | 10 |

Cast Iron Pipe:

|              |   |
|--------------|---|
| 6" and under | 5 but not less than one support per pipe length |
|--------------|---|

- B. Vertical pipe runs shall be supported and laterally braced at every floor level in multi-story structures and laterally braced only, at intervals not exceeding 15' (10' for 3" pipe and under) in other structures.

### 3.3 EXPANSION & ADHESIVE ANCHOR

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

### 3.4 SEISMIC BRACING

- A. Provide seismic (lateral) bracing for all piping with hanger length greater than 12" from the top of the pipe to the bottom of the support for the hanger.
- B. Contractor shall field locate bracing. Bracing shall be installed in such location and manner so as not to restrict thermal movement for hot piping.
- C. Unless otherwise shown, a pipe hanger used for lateral bracing shall include the following:
1. Clevis type hanger with pipe sleeve over horizontal through bolt.
  2. 2 x 2 x 3/16 diagonal (1:1 slope) angle strut attached with bent clip angle to one side of hanger at through bolt. Weld or bolt other end of diagonal to support structure.

3. 2 x 2 x 3/16 angle to brace hanger rod for rods over 3' long. Weld angle to rod with 1/8" weld spaced 1" at 24" on center.

**END OF SECTION 230529**

## **SECTION 230553 – IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT**

### **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 SCOPE**

- A. The Contractor shall furnish and install identification labels for HVAC piping and equipment.

#### **1.3 SUBMITTALS**

- A. Manufacturer's data sheet for identification labels.
- B. Samples for identification labels.
- C. Label Schedule, including a listing of all piping, duct, and equipment to be labeled with proposed content and coloring for each label.

### **PART 2 - PRODUCTS**

#### **2.1 GENERAL**

- A. Before ordering labels, Contractor shall review the proposed location for each label with the Owner's Representative and make any revisions to location or content as directed.
- B. Contractor shall be responsible for obtaining all dimensions required to properly size and order labels.

#### **2.2 LABELS**

- A. Label shall be heavy duty, self-adhesive, plastic type, rated for -40°F to 175°F surface temperature, which comply with ANSI/OSHA standards, Seton Opti-Code Self-Adhesive Pipe Labels or approved equal by Brady, Clarion or Kolbi.
- B. Label lettering shall be minimum 3”.
- C. Label lettering shall be in accordance with manufacturer's recommendations.
- D. Color coding shall comply with ANSI 13.1, latest.
- E. Wording/color combinations shall be manufacturer's standard.
- F. Direction of flow shall be included on each piping and duct label.
- G. Piping Labels: Provide labels for the piping systems in accordance with Appendix A.
- H. Duct Labels: Include identification of duct service using same designation or abbreviations as indicated on the drawings.

- I. Equipment Labels: Include equipment's unique equipment number as indicated on the drawings. Confirm equipment name and number with Owner's Representative prior to proceeding.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Apply labels only after installation, painting, and insulating have been completed.
- B. All surfaces shall be cleaned of all scale, rust, oil, and foreign matter and shall be dry and free of frost prior to and during application of labels.

### **3.2 LABEL LOCATION**

- A. Review location of labels with Owner's Representative prior to installing.
- B. Locate labels to be read easily from floor or platform levels.
- C. Piping Labels: Locate labels as follows, unless indicated otherwise by Owner's Representative:
  1. Within 10' of connected equipment.
  2. At intervals not exceeding 30' of pipe.
  3. At branch points.
  4. At every sectionalizing or main shutoff valve.
  5. On each riser at a point 5' above floors and platforms.
  6. Near points where pipes enter or leave concealed spaces.
  7. At access doors, panels, or manholes which permit view into concealed spaces.
  8. Where flow pattern is not obvious.
- D. Duct Labels: Locate labels as follows, unless indicated otherwise by Owner's Representative:
  1. Within 10' of connected equipment.
  2. At intervals not exceeding 30' of duct.
  3. At branch points.
  4. On each riser at a point 5' above floors and platforms.
  5. Near points where ducts enter or leave concealed spaces.
  6. At access doors, panels, or manholes which permit view into concealed spaces.
- E. Equipment Labels: Locate labels as follows, unless indicated otherwise by Owner's Representative:
  1. On equipment where accessible and visible.

## **PART 4 - APPENDIX "A"**

### **4.1 PIPE IDENTIFICATION SCHEDULE**

| <u>Piping System</u> | <u>Symbol</u> | <u>Label Legend</u>                |
|----------------------|---------------|------------------------------------|
| Fuel Oil             | FOS/FOR       | Fuel Oil Supply<br>Fuel Oil Return |
| Engine Exhaust       | EE            | Engine Exhaust                     |
| Vent                 | V             | Vent                               |
| Drain                | D/CD          | Drain                              |

**END OF SECTION 230553**

## SECTION 232000 – PIPING 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 SCOPE

- A. The Contractor shall furnish and install all HVAC piping as shown on the Drawings and specified herein.

#### 1.3 GENERAL

- A. Piping shall be fabricated and installed in accordance with the Code for Pressure Piping, ANSI B31.1 (Latest) "Power Piping".

#### 1.4 SUBMITTALS

- A. Submit product data:
  - 1. Piping materials
  - 2. Solder filler metal for copper tube
  - 3. Integrally reinforced branch fittings
  - 4. Anti-sieze compound
- B. Welder test reports.
- C. Weld inspector qualifications.
- D. Weld test reports.
- E. Leakage test reports.

### PART 2 - PRODUCTS

#### 2.1 FABRICATION

- A. Piping fabrication and materials for the various systems shall be in accordance with the schedule below and the piping specifications that follow this section.

| <u>Piping System</u> | <u>Symbol</u> | <u>Piping Specification No.</u> |
|----------------------|---------------|---------------------------------|
| Fuel Oil             | FOS/FOR       | 1                               |

- B. All pipe materials shall be new, clean, and free of debris.
- C. All pipe and large bore fittings shall be delivered to the site with plastic end caps.

## **PART 3 - EXECUTION**

### **3.1 PIPE ERECTION**

- A. Carefully inspect all pipe, fittings, valves, equipment, and accessories prior to installation. Any items which are unsuitable, cracked or otherwise defective shall be rejected and removed from the job immediately.
- B. Pipe lines shall be run straight and true with a minimum use of joints and with only such offsets as may be required to clear interferences and to provide necessary clearance or headroom or provide the necessary flexibility in the piping system.
- C. Changes in direction of pipe lines shall be made with approved fittings or pipe bends only.
- D. Miter joints in welded pipe assemblies shall not be used except where shown on the Drawings.
- E. Backing rings shall not be used on butt welded joints.
- F. Tubing shall be installed with the use of tubing bends, to the maximum extent possible to minimize the use of fittings.
- G. All prefabricated piping shall be arranged with extra tangent, loose flanges, field joints or other provisions to permit field adjustment to suit construction tolerances and to avoid interferences. No claims for extras for reworking prefabricated piping will be allowed other than for a major change in plans.
- H. Provide flanges or unions at all final connections to equipment, traps, and valves to facilitate dismantling. Arrange piping and piping connections so that equipment being served may be serviced or totally removed without disturbing piping beyond final connections and associated shut-off valves.
- I. Pipe shall be cut to exact measurement and installed without springing or forcing. Particular care shall be taken to avoid creating, even temporarily, undue loads, forces or strains on valves, equipment or building elements with piping connections or piping supports.
- J. All cutting residue shall be cleaned from the interior of pipe prior to welding or joining.
- K. All instrument tubing shall be run in a neat, straight fashion free from waves.
- L. All flange bolts and nuts shall have threaded surfaces thoroughly coated with high temperature, anti-sieze paste. The paste shall be Nickel Grade Anti-Sieze (Lub-O-Seal Company, Inc.) or approved equal.
- M. Flange bolts shall be properly tightened with torque wrenches to gasket manufacturer's requirements. See attachment to this specification.
- N. Slugging wrenches and pneumatic impact wrenches shall not be used for tightening flange bolts.
- O. All threaded pipe work is to be assembled with full threads, including all fittings, valves, unions, and specialties.
- P. Threads shall be full and clean cut and the pipe shall be reamed and filed, removing all burrs from the interior.

- Q. Threaded work shall be made up with a suitable pipe joint compound.
- R. Mating flanges shall have same type face. Raised face flanges shall have raised portion machined off before bolting to flat face flanges.
- S. All pipe shall be erected and supported in such a manner as to provide for expansion and contraction without harmful strain to the building structural members, pipe and pipe supports.
- T. Consideration shall be given to insulation thickness when routing piping such that adequate clearance is provided to avoid interfering with insulation.

### **3.2 BRANCH CONNECTIONS**

- A. Branch connections shall be made with standard tees and 45° laterals of the type required for the service.
- B. In place of standard tees and 45° laterals in black steel piping systems, Contractor may use integrally reinforced weld-on fittings only where specifically shown on the Drawings.
- C. Integrally reinforced branch connections shall maintain full pipe strength and shall comply with ANSI B31.1, ANSI B16.9, and MSS-SP-97 Standard – Integrally Reinforced Forged Branch Outlet Fittings. Fittings shall be Bonney Forge Weldolet or approved equal.

### **3.3 DRAINING AND VENTING**

- A. Unless otherwise indicated on the Drawings, all horizontal lines, including runouts and branches, shall pitch to low points to provide for complete drainage or removal of condensate and venting. Slope unless otherwise indicated, shall be 1" in 40'.
- B. Maintain constant slope where lines are pitched for venting and drainage. No lines shall have pockets due to changes in elevation unless indicated on the Drawings. In such instances proper provisions for draining and venting shall be provided.
- C. Provide 3/4" drain valves fitted with 3/4" hose thread adapter at all low points of process or water piping systems and where indicated on Drawings to permit complete or sectionalized draining.
- D. Provide manual air vents with 3/4" vent valves at the high points of piping systems and where shown on Drawings.

### **3.4 SLEEVES**

- A. Furnish and install sleeves for all pipes passing through floors and walls, slabs, grade beams and foundations.
- B. When possible, layout, size and locate all sleeves such that they are installed prior to pouring concrete or when masonry is being constructed.
- C. Sleeves shall be standard weight galvanized steel pipe, or 10-gauge galvanized sheet metal to be closed with longitudinal weld joint, having square cut ends with anchoring lugs welded on.
- D. Horizontal sleeves through walls, grade beams, foundations and partitions shall be grouted in place and shall be flush with finished wall faces.



- E. Vertical sleeves through floors shall extend 2" above finished floor and be flush on under side.
- F. Size sleeves such that internal diameter is 2" larger than O.D. of bare pipe for uninsulated lines and 2" larger than O.D. of insulation and jacket for insulated lines.
- G. Center pipes in sleeves. Sleeves in pits or below grade shall be painted or coated with one coat of coal tar paint.
- H. Roof openings shall have collars flashed into roofing system and weather hoods attached to pipe as shown on the Drawings. Final detail shall comply with roofing manufacturer's requirements.

### **3.5 FIRE-RESISTANCE-RATED ASSEMBLY PENETRATIONS**

- A. Fire-Resistance-Rated Assembly Penetrations: Where pipes pass through fire-resistance-rated walls, partitions, ceilings, or floors, the fire rated integrity shall be maintained by special sealers and materials with UL Listed through-penetration fire stop systems.

### **3.6 DIELECTRIC CONNECTIONS**

- A. Pipe joints connecting dissimilar metals shall be insulating, dielectric connections. Such joints, including dielectric material, shall be rated to withstand the temperature, pressure, and other characteristics of the service for which it is to be used, including testing pressure.
- B. Screwed joints shall be made with insulating unions and couplings.
- C. Flanged joints shall be made up with flange insulation kits consisting of a suitable gasket, bolt sleeves and washers.

### **3.7 WELD TESTING**

- A. The Contractor shall test all pipe welds for proper quality using nondestructive, ultrasonic testing procedures in accordance with the applicable ANSI/ASME codes.
  - 1. Testing will be completed by Contractor's third party, certified weld inspector, subject to approval of Construction Representative and Engineer.
- B. Contractor shall complete any required repairs at Contractor's cost.

### **3.8 LEAKAGE TESTING**

- A. Tests shall be performed and approval of tests obtained in writing prior to cleaning, backfilling, insulating, painting, or concealing pipe.
- B. Notify Owner's Representative 24 hours in advance of testing.
- C. Prepare and keep records of each system or section of system tested. Test reports shall be signed as approved by Owner's Representative with four (4) copies to Owner's Representative. If additional copies are required by those persons having legal jurisdiction, Contractor shall furnish them. Test reports shall include, but not necessarily be limited to, the following.
  - 1. Identification of piping system or section tested.

2. Date of test and date of Owner's Representative approval signature.
  3. Testing medium and method or description of test procedure.
  4. Test pressure, duration of test and recorded pressure drop.
- D. Pressure tests shall apply to piping only with all equipment, traps, relief valves and instruments blocked off or disconnected. In no case shall piping or any component be subjected to pressures exceeding 90% of their published rating. All system valves within section being tested shall be open. Provide temporary restraints on expansion joints and flexible connections during pressure testing.
- E. The Contractor shall provide all compressors, pumps, gauges, pipe, fittings, closures, etc., required for the tests. Blanks shall be furnished and installed wherever necessary to prevent cold test water from coming in contact with hot valves. Remove blanks after testing.
- F. Unless otherwise indicated hydrostatic testing medium shall be potable water and pneumatic testing medium shall be compressed air.
- G. Pneumatic testing for any purpose shall require evacuation of all personnel not directly involved in performing test and preliminary test of 25 psig. Swab all joints with standard high film strength soap solution and check for bubbles.
- H. Pneumatic tests may be substituted for specified hydrostatic tests where freezing conditions may occur when approved by Owner's Representative.
- I. Hydrostatic and pneumatic tests shall apply to piping as indicted in the following schedule.
1. The pressure shall be gradually raised to the value given and the source then blocked off.
  2. Pressures shall be observed after the pipe and contents have stabilized at the ambient temperature and the source of test pressure shut-off.
  3. All joints shall be visually examined during test.
  4. Leaks shall be repaired and complete testing procedure repeated.
  5. Upon successful completion and approval of the tests, the piping shall be relieved of pressure, drained, dried, cleaned and put into normal operation except for potable water which shall first be disinfected.

#### LEAKAGE TEST SCHEDULE

| <u>Service</u>     | <u>Operating<br/>Pressure<br/>psig</u> | <u>Hydrostatic<br/>Test Pressure<br/>psig</u> | <u>Minimum Time<br/>Hours</u> |
|--------------------|--|---|-------------------------------|
| Fuel Oil (FOS/FOR) | to 100                                 | 150   | 2                             |

- J. All new piping not specifically listed above shall receive an initial service leak test by gradually bringing the system up to normal operating pressure for at least 10 minutes while examining for leaks.

### 3.9 CLEANING

- A. Prior to assembly of pipe and piping components, all loose dirt, scale, oil, and other foreign matter on internal or external surfaces shall be removed by means consistent with good piping practice. Chips and burrs from thread cutting operations shall be blown out of pipe before assembly. Cutting oil shall be removed from internal and external surfaces.

- B. During fabrication and assembly, slag and weld spatter shall be removed from pipe joints by peening, chipping, and wire brushing.
- C. Contractor shall arrange for visual inspection of all pipe by Owner's Representative prior to closure.
- D. All completed piping systems except those listed immediately below shall be cleaned:
  - 1. Vent
  - 2. Drain
- E. Notify Owner's Representative prior to starting any cleaning operation. Consult with Owner's Representative with regard to scheduling.
- F. It shall be Contractor's responsibility to arrange for proper disposal of cleaning and flushing fluids.
- G. Prior to blowing or flushing piping systems, disconnect all instrumentation and equipment, open wide all valves, and be certain all strainer screens are in place.
- H. Water Flush: Flush pipe and components with clean water until all discharge from system is clean. Flow shall be in same direction as when system is in normal operation. Discharge shall be from low points of lines, ends of headers and as otherwise required to flush entire system. Water flush shall apply to the following systems:
  - 1. Not used.
- I. Oil Flush: Flush pipe and components with the service fluid until the discharge from each system is clean. Flow shall be in the same direction as when system is in normal operation. Used cleaning fluid shall be drained into containers. These containers shall be disposed of off the job site by Contractor in a manner which fully complies with all federal, state, and local pollution regulations. Oil flush shall apply to the following systems:
  - 1. Fuel Oil.
- J. Air Blow: Blow out pipe and components with dry oil free air, or nitrogen. Where air supply is judged to be inadequate to continually attain cleaning velocity, alternate pressurization and sudden relief procedure may be used until discharge at all blow out points is clean. Use 80-90 psig pressure unless otherwise indicated. Air blow cleaning shall require evacuation of all personnel not directly involved in the cleaning operation. Air blow shall apply to the following systems:
  - 1. Fuel Oil (as an alternative to oil flush).
- K. Following flushing or blowing operations, all items disconnected or blanked off shall be reconnected. Strainer screens shall be removed, cleaned, and replaced.
- L. Repeat cleaning as required to obtain a contamination-free system.

### **3.10 FINAL INSPECTION AND ADJUSTING**

- A. After each installation is completed, tested for leaks, cleaned, and approved by the Owner's Representative, it shall be filled with the fluid it is to carry.

- B. The Contractor shall then test each system in actual operation, operate all valves, safety devices and equipment which he has installed and make final adjustments to place the system in operation.
- C. Such operation shall be demonstrated to the satisfaction of the Owner's Representative.

## PIPING SPECIFICATION NO. 1

General Use: Fuel Oil (FOS/FOR)

Fabrication: 2" and under: Socket Welded  
2-1/2" and above: Butt Welded and Flanged

Pipe: Seamless Carbon Steel, ASTM A53 or A106, Grade B, ANSI B36.10  
2" and under: Schedule 80  
2-1/2" and above: Schedule 40 to 10", 0.375" wall for 12" and above.

Fittings: 2" and under: Class 3000, forged steel, socket weld fittings, ASTM 105, ANSI B16.11.  
  
2-1/2" and above: Butt welding, carbon steel, ASTM A234, ANSI B16.9  
  
Elbows to be long radius for 12" or lower diameter pipe unless otherwise shown on the Drawings.  
  
Elbows to be short radius for 16" or greater diameter pipe unless otherwise shown on the Drawings.  
  
Use Standard Weight with Schedule 40 and 0.375" wall pipe, Extra Heavy with Schedule 80 pipe.

### Unions and

Flanges: Unions: Class 3000, forged steel, socket weld, ASTM A105, ANSI B16.11, MSS-SP-83.

Flanges: Class 150, forged steel, welding neck, ASTM A105, ANSI B16.5 (24" or less), ANSI B16.47 Series A (26" – 30"), raised face with surface finish suitable for the specified gasket.

Gaskets: 1/16" compressed graphite fiber with nitrile binder, fire safe, Garlock G-9900.

Bolting: ASTM A193, Grade B7 alloy steel stud bolts, ASTM A194 Grade 2H heavy semi-finished hex nuts.

Notes:

1. Backing or chill rings are not allowed.
2. Note pipe weld inspection requirements in this Section and Section 230501, General Mechanical Requirements for HVAC, paragraph 3.6, Thermal Metal Joining and Cutting.
3. Above-ground fuel oil piping systems shall be listed and labeled in accordance with UL1369, Standard For Aboveground Piping For Flammable And Combustible Liquids, and shall comply with International Mechanical Code, NFPA 30, Flammable and Combustible Liquids Code, and NFPA 31, Standard for the Installation of Oil-Burning Equipment.

## **END OF SECTION 232000**

## **SECTION 232116 – PIPING SPECIALTIES**

### **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 SCOPE**

- A. Contractor shall furnish and install all piping specialties as shown on the Drawings and specified herein.

#### **1.3 SUBMITTALS**

- A. Manufacturer's data sheets
- B. Performance Curves
- C. Motor Data
- D. Wiring Diagrams
- E. Factory Test Reports
- F. Factory Calibration Reports
- G. Field Calibration Reports
- H. Field Inspection Reports

#### **1.4 QUALITY CONTROL**

- A. Instruments shall be factory calibrated with devices traceable to the National Institute of Standards and Technology (NIST).

### **PART 2 - PRODUCTS**

#### **2.1 FLEXIBLE CONNECTORS**

- A. Provide flexible connectors as shown on the Drawings and specified herein.
- B. Fuel Oil: Flexible connector for fuel oil piping shall be NFPA 30/30A compliant, metal type complying with UL 2039, Flexible Connector Piping for Fuels, UL Listed and Labeled. Flexible connector shall be corrugated 316L/321 stainless steel with 304L stainless steel braid. End fittings shall be stainless steel, schedule 80, Hex male NPT, rated for 100 psig working pressure and full vacuum at 70°F. Flexible connections shall be 12" long unless noted otherwise on the Drawings. Connectors shall be OmegaFlex DoubleTrac, or approved equal by Franklin Fueling Systems, Flex-Hose Co. Inc., Hose Master, Minnesota Flexible Corporation, OPW Fueling Components.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install piping specialties in full accordance with manufacturer's instructions.

### **3.2 FLEXIBLE CONNECTORS**

- A. To insure proper joint alignment, the piping shall be made up "solid" and anchored and then a section of pipe shall be cut out and the connector installed into the pipe line.
- B. Install unions on both ends of flexible connectors with threaded connections.
- C. Do not compress or extend axially, torque, or allow movement in multiple plans.
- D. Use pipe elbows to avoid sharp bends in connector. Maintain manufacturer's minimum centerline bend radius.
- E. Properly support and anchor piping to prevent pipe gravity and pressure thrust loads on flexible connectors.

### **3.3 INSTRUMENTS**

- A. Field check instrument calibration with devices traceable to National Institute of Standards and Technology (NIST).
- B. Gauges shall be installed so as to be visible from adjacent walkways, platforms, etc.
- C. Thermometers shall be installed so as to be visible.
- D. Thermowell shall be filled with heat transfer gel prior to inserting thermometer stem.
- E. For thermometers in pipe diameters 2" or less, install a minimum 2-1/2" x 2-1/2" tee with appropriate bushings, reducers, nipples, etc., in the line pipe.
  - 1. Install the well into the tee with appropriate bushing nipples, caps. etc., as required to obtain thermowell insertion to pipe centerline without causing a flow restriction.

**END OF SECTION 232016**

# **SECTION 260115 – PREVENTATIVE MAINTENANCE FOR 4.16 kV ELECTRICAL EQUIPMENT**

## **ALTERNATE BID NO. 3**

### **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 SCOPE**

- A. The Contractor shall provide the equipment manufacturers' recommended preventative maintenance for the outdoor 4.16 kV main switchgear and outdoor metal-enclosed 4.16 kV automatic transfer switchgear in accordance with the equipment manufacturers' instruction manuals and industry standards.

#### **1.3 RELATED SECTIONS**

- A. Section 260500 – Common Work Results for Electrical
- B. Section 260573 – Protective Device Coordination Study and Arc Flash Risk Assessment

#### **1.4 COORDINATION**

- A. It is the intent that the work specified herein shall be coordinated with all other Division 26 work in order to reduce the number and duration of power outages to the facility to the greatest extent possible.
- B. Schedule the work specified herein for the 4.16kV main switchgear to occur after the new 1000 kW standby-duty rated diesel-engine-driven generator has been installed and is fully functional such that the new generator can power the facility during the utility power outage that will be required to complete the work.
- C. Execute the work specified herein for the outdoor metal-enclosed 4.16 kV automatic transfer switchgear during a facility power outage that is no longer than eight (8) continuous day-light hours on a weekday.
- D. This work must be scheduled with, and approved by, the Facility a minimum of two weeks in advance.

#### **1.5 SUBMITTALS**

- A. Qualification data for preventative maintenance services provider organization.
- B. Qualification data, including training certification data, for field services technicians certifying adequate training and experience for the specific type equipment involved on this project.
- C. List of test equipment to be used in the performance of the preventative maintenance services, including manufacturer and model number for each item.



- D. Calibration certificate for each piece of test equipment, including torque wrenches, to be used in the performance of the preventative maintenance services.
- E. Copies of standard forms used for testing and recording field data for the 4.16 kV switchgear and 4.16 kV automatic transfer switchgear.

## 1.6 APPLICABLE STANDARDS

- A. The work specified herein shall be governed by the latest applicable ANSI, NEMA and NFPA standards, including but not limited to:
  1. ANSI/IEEE C37.04 IEEE Standard Rating Structure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis
  2. ANSI/IEEE C37.06 Switchgear - AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis - Preferred Ratings and Related Required Capabilities
  3. ANSI/IEEE C37.09 IEEE Standard Test Procedure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis
  4. ANSI/IEEE C37.010 IEEE Application Guide for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis
  5. ANSI/IEEE C37.011 IEEE Application Guide for Transient Recovery Voltage for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis
  6. ANSI/IEEE C37.012 IEEE Application Guide for Capacitance Current Switching for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis
  7. ANSI/IEEE C37.11 IEEE Application Guide for Electrical Control of AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis
  8. ANSI/IEEE C37.20.2 IEEE Standard for Metal-Clad and Station-Type Cubicle Switchgear
  9. ANSI/IEEE C37.55 Metal-Clad Switchgear Assemblies - Conformance Testing Procedures
  10. ANSI/IEEE C37.90 Standard for Relays and Relay Systems Associated with Electric Power Apparatus
  11. ANSI/IEEE C39.1 Requirements for Electrical Analog Indicating Instruments
  12. ANSI/IEEE C57.13 IEEE Standard Requirements for Instrument Transformers
  13. ANSI/IEEE 450 Recommended Practice for Maintenance, Testing and Replacement of Large Lead Storage Batteries for Generating Stations and Substations

|     |                      |     |   |
|-----|----------------------|-----|---|
| 14. | ANSI/NETA            | MTS | Standard for Maintenance Testing Specifications for Electrical Power Equipment and Systems (Latest Edition) |
| 15. | NEMA CC1             |     | Electrical Power Connectors for Substations   |
| 16. | NEMA SG-2            |     | High Voltage Fuses  |
| 17. | NEMA SG-4            |     | Alternating-Current High-Voltage Circuit Breakers   |
| 18. | NEMA SG-5            |     | Power Switchgear Assemblies   |
| 19. | NEMA 250             |     | Enclosures for Electrical Equipment   |
| 20. | NFPA 70              |     | National Electrical Code, 2020 Edition  |
| 21. | NFPA 70B             |     | Recommended Practice for Electrical Equipment Maintenance, 2019 Edition                                     |
| 22. | NFPA 70E             |     | Standard for Electrical Safety in the Workplace, 2018 Edition   |
| 23. | OSHA 29 CFR 1910 - S |     | Occupational Safety and Health Standards – Subpart S – Electrical   |
| 24. | UL 1008A             |     | Transfer Switch Equipment, Over 1000 Volts  |

#### **1.7 NECESSARY EQUIPMENT FOR 4.16 kV SWITCHGEAR AND 4.16 kV AUTOMATIC TRANSFER SWITCHGEAR SERVICE**

- A. Provide the following items as applicable for performance of the preventative maintenance services specified herein:
1. Personnel protective equipment in accordance with NFPA 70E
  2. Project folder/notebook for documentation of test results and findings
  3. Standard medium-voltage switchgear accessories and maintenance tools
  4. Standard medium-voltage vacuum breaker accessories and maintenance tools
  5. Insulation resistance test set – 1000 VDC minimum
  6. Low resistance digital ohmmeter – 10 amp minimum
  7. Specimen grounding jumpers and ground mats
  8. Torque wrenches, pound-inches and pound-feet
  9. Phase rotation meter
  10. RMS digital multimeter
  11. Phase angle meter
  12. Secondary injection test set
  13. AC/DC power supply
  14. Variable current source
  15. Current transformer test set
  16. AC HiPotential test set – 60 Hz
  17. Shopvac

18. Lock-out/Tag-out

**1.8 ACCEPTABLE PROVIDERS**

- A. The preventative maintenance services for the 4.16 kV main switchgear and 4.16 kV automatic transfer switchgear and all associated equipment and accessories shall be provided by one of the following:
1. ABB Services  
Kansas City, KS  
(913) 286-8028  
Roger Andrews
  2. Eaton Engineering Services and Systems  
62 Soccer Park Rd.  
Fenton, MO 63026  
(262) 309-3440  
Brad Gilmer
  3. Schneider Electric Services  
801 Corporate Center Dr.  
O'Fallon, MO 63368  
(314) 378-2407  
Michael Berra

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

**PART 3 - EXECUTION**

**3.1 ACTIVITIES PRIOR TO PREVENTATIVE MAINTENANCE SERVICE AND TESTING**

- A. Procure and Review:
1. Equipment drawings, schematics and wiring diagrams associated with equipment/device being tested (Owner has on file)
  2. Instruction bulletins/books (Owner has on file)
  3. Protective device coordination study and arc flash risk assessment provided under Section 260573 – Protective Device Coordination Study and Arc Flash Risk Assessment
  4. Test data and field service forms
  5. Safe working procedures and MSDS forms that apply to the equipment/device being tested
  6. Site safety rules and emergency procedures
  7. Site plan (Project Drawings ES-102)
  8. Site electrical one-line diagrams (Project Drawings E-601 & E-602)
- B. Preparation and Safety (NOTE: The following recommendations are not intended to take precedence over the Contractor's safety procedures or industry standards. The Contractor shall be responsible for the safety of all personnel on-site and for any damage to Owner's equipment caused by Contractor's action, inaction, willful act and/or negligence.)

1. Ensure that the new 1000kW diesel-engine-driven generator installation is complete is fully functional such that it will power the facility during the time the utility power is shut off for completion of the work specified herein.
  2. Contact Ameren Missouri for disconnection of the incoming utility power to the 4.16 kV main switchgear and apply safety grounds on the line side bus of the switchgear.  
NOTE: Ameren Missouri may choose to apply their own safety grounds.
  3. Apply lock-out/tag-out to all open switches and circuit breakers.
- C. Verify:
1. The equipment nameplate ratings are consistent with the equipment drawings provided.
  2. Suitability of tools and test equipment for use on the equipment to be tested.
  3. Test data and field service forms are available with the following data to be recorded prior to the start of testing:
    - a. Customer and project information
    - b. Equipment designation from site one-line diagram and equipment schedules
    - c. Serial number of equipment, if applicable
    - d. Field data
    - e. Equipment ratings; e.g., voltage, current, control voltage, short circuit current rating, interrupting rating, etc.
    - f. Vacuum circuit breaker operations counter reading as found prior to the start of testing
    - g. As found conditions of equipment prior to the start of testing
    - h. Temperature, humidity and general weather conditions at the time of testing
    - i. Date and time of testing
    - j. Test equipment data
    - k. Field service technicians name and company information
    - l. As found circuit breaker and protective relay settings prior to testing

### 3.2 INSPECTION AND TEST PROCEDURES

- A. As a minimum, perform the following inspection, testing and preventative maintenance activities for all equipment. Report serious deficiencies immediately to the responsible contact at the Facility.
1. Examine 4.16 kV switchgear line-up including all load-interrupter switches, vacuum circuit breaker and accessories for:
    - a. Loose or obviously damaged components
    - b. Proper identification
    - c. Proper application of the vacuum circuit breaker with the cell

- d. Proper application of the load-interrupter switches and fuses
  - e. Compliance to switchgear drawings
  - f. Doors, panels, and sections for alignment, dents, scratches, fit and missing hardware
  - g. Maintenance accessories for servicing and operating all devices
2. Inspect switchgear for:
- a. Inspect all grounding connections for cleanliness and alignment
  - b. Main bonding jumper for proper size and termination per NEC 250
  - c. Insulators for evidence of physical damage or contaminated surfaces
  - d. Surge arrester size, type, installation and connection to verify compliance with switchgear drawings and NEC 242
  - e. Circuit breaker cell, primary and secondary disconnects for physical condition, cleanliness and lubrication.
  - f. Load-interrupter switches and fuse mountings for physical condition, cleanliness and lubrication
  - g. Alignment and penetration of instrument transformer withdrawal disconnects, current carrying, and grounding components
  - h. Control power transformers
  - i. Wiring for damaged insulation, broken leads, tightness of connections, proper crimping, and overall general condition
  - j. Structure, grounding, cables and bus assembly
  - k. Verify the grounding electrode conductor is properly sized in accordance with NEC 250 and is properly terminated
  - l. Verify the proper grounding of instruments, panels, and connections per NEC 250
  - m. Verify that conductors are properly identified
  - n. Verify cable termination tightness to manufacturer's published values by calibrated torque wrench
  - o. Verify integrity of insulation on bus bars and cable to bus connection
  - p. Verify tightness of accessible bolted electrical connections by calibrated torque wrench in accordance with manufacturer's published values
  - q. Verify correct barrier and shutter installation and operation
  - r. Verify that filters are in place and/or vents are clear from obstructions
  - s. Control and instrumentation:
    - 1) Verify that all PT (VT) and CT ratios properly correspond to drawings and that polarity is correct
    - 2) Verify that shorting screws and bars are removed from CT's and terminal blocks as required
    - 3) Verify the primary and secondary fuse ratings or circuit breakers match the switchgear drawings

- 4) Verify meter scaling and type match the switchgear drawings
- 5) Verify that accessible moving components are adequately lubricated per the equipment manufacturer's recommendations
- t. Key Interlock Systems
  - 1) Verify key number and exchange codes
  - 2) Verify proper sequencing to comply with switchgear drawing notes
  - 3) Attempt to close locked-open devices
  - 4) Attempt to open locked-closed devices
  - 5) Make key exchange with devices operated in off-normal positions
  - 6) Disposition of duplicate keys found shall be per the Owner's safety policy
- u. With each load-interrupter switch/breaker open, inspect:
  - 1) Primary leads, insulators, and disconnects
  - 2) Ground contact, secondary disconnect, close and trip interlocks, levering latch, MOC and TOC operators, and all other interlocks
- v. Verify manual operation of each load-interrupter switch and vacuum circuit breaker
  - 1) Charge closing spring using maintenance tool (manual charge handle), then remove handle
  - 2) Verify Charged/Discharged status indicators function properly
  - 3) Close breaker manually and verify Closed and Discharge indicator
  - 4) Charge breaker again and verify that the breaker stays closed
  - 5) Trip breaker manually and verify Open indicator
  - 6) Repeat several times to confirm mechanism operates consistently and reliably
  - 7) Charge closing spring and close manually
- w. With each load-interrupter switch closed:
  - 1) Inspect contact wipe ("T" Slot)
  - 2) Measure contact resistance using a 10 amp minimum DC source and compare with previous results if information is available
  - 3) Open load-interrupter switch
- x. With the circuit breaker closed:
  - 1) Inspect contact erosion indicator mark on vacuum interrupter moving stem
  - 2) Inspect contact wipe ("T" Slot)
  - 3) Measure contact resistance using a 10 amp minimum DC source and compare with previous results if information is available

- 4) Perform “CLOSED” portions of AC high potential test (vacuum integrity test)
- 5) Open breaker
- y. With each load-interrupter switch/vacuum circuit breaker open:
  - 1) Perform the “OPEN” portion of AC high potential test
  - 2) Perform vacuum integrity test according to the instruction book and at the OEM recommended voltage level. **Do not exceed maximum voltage level stipulated for this test. Provide adequate barriers and protection against x-radiation during this test.**
  - 3) NOTE: Some DC high potential test sets are half-wave rectified and may produce peak voltages in excess of the breaker manufacturer’s recommended maximum. It may also give erroneous indication of loss of vacuum of the interrupter.
- z. Perform control wiring AC high potential test at 1,125V RMS. **Do not perform this test on wiring connected to solid state components.**
- aa. Rack the breaker into the cell (“Test Position” if applicable) using the standard breaker maintenance accessories and check for binding or hesitation and the movement of the breaker position indicator.
- bb. Verify the proper operation of all breakers/cell accessories, shutters, auxiliary switches, cell MOC and TOC switches, key interlocks, and cell status indicators
- cc. Verify the proper operation of all breaker/cell interlocks as applicable:
  - 1) Maintenance interlock
  - 2) Levering interlock
  - 3) Positive interlock
  - 4) Negative interlock
  - 5) Positive closing interlock
  - 6) Extension rail interlock
  - 7) Breaker/cell rating code interlock
  - 8) All other devices
- dd. Capacitive trip devices:
  - 1) Verify proper operation per manufacturer’s specifications
  - 2) Replace batteries, if applicable
- ee. Inspect automatic transfer controls and operating mechanism

B. As a minimum, provide the following electrical testing on the switchgear:

1. Insulation system:
  - a. Perform insulation-resistance tests on each bus section, phase-to-phase and phase-to-ground. Values shall be in accordance with manufacturer’s published data.

- b. Perform insulation-resistance tests at 500 VDC on all control wiring. **Do not perform this test on wiring connected to solid-state components.**
- 2. Automatic Transfer Control
  - a. Verify settings of all timers
  - b. Test automatic operation of the automatic transfer switchgear in from utility to emergency source and from emergency source to the utility.
  - c. Test manual operation of the automatic transfer switchgear with automatic controls disabled.
- 3. Control and Instrumentation:
  - a. Perform the following tests on control power transformers:
    - 1) Insulation-resistance tests. Perform measurements from winding-to-winding and each winding-to-ground. Test voltages shall be as specified by the equipment manufacturer.
    - 2) Verify correct secondary voltage by energizing primary winding with system voltage. Measure secondary voltage with the secondary winding connected.
    - 3) Perform secondary wiring integrity test. Confirm potential at all devices.
    - 4) Verify correct function of control transfer relays located in switchgear.
    - 5) Verify operation of switchgear anti-condensation space heaters.
  - b. Perform the following tests on potential transformers:
    - 1) Perform insulation-resistance tests. Perform measurements from winding-to-winding and each winding-to-ground. Test voltages shall be as specified by the equipment manufacturer.
    - 2) Verify correct secondary voltage by energizing primary winding with system voltage. Measure secondary voltage with the secondary winding connected.
    - 3) Perform secondary wiring integrity test. Confirm potential at all devices.
  - c. Perform the following tests on current transformers:
    - 1) Ratio
    - 2) Saturation
- 4. Protection devices:
  - a. Verify settings for all protective relays per the protective device coordination study and arc flash risk assessment provided under Section 260573 – Protective Device Coordination Study and Arc Flash Risk Assessment.
  - b. Adjust settings to agree with the Settings Table in the report as required.
  - c. Determine accuracy of protective relays in accordance with the manufacturer’s instructions and industry standards.
- 5. Metering:



- a. Verify operation and proper set-up of all metering devices.
  - b. Determine accuracy of meters in accordance with the manufacturer's instructions and industry standards.
- C. As a minimum, provide the following system function testing on all power circuit breakers and cells:
  - 1. Check for the correct value of control power for close and trip functions prior to racking breaker into cell.
  - 2. Verify the electrical operation of the breaker (in the test position or with auxiliary cable)
    - a. Perform close, trip, and anti-pump tests
  - 3. Verify operation of the breaker from all local and remote-control switches or terminal blocks.
    - a. Close and Open the breaker from each controllable device in the circuit
    - b. Verify proper operation of circuit breaker position indicator on breaker control switches
    - c. Confirm which tests must be performed with the breaker in the "Test Position."
  - 4. Verify that each protective relay and lock-out (86) device trips the breaker as designed.
- D. Perform the following after completion of testing.
  - 1. Before re-energizing the equipment:
    - a. Record the "as left" operations counter value on all circuit breakers
    - b. Remove metal shavings and thoroughly clean and vacuum the equipment. Use only cleaning products recommended by the equipment manufacturer. No petroleum- based cleaners of any kind shall be used.
    - c. Remove and account for all test equipment, jumper wires, and tools used during testing
    - d. Remove and account for all safety grounds and tools
    - e. Replace all barriers and covers, close all doors, and secure all latches. Do not use power actuated tools to install threaded fasteners to avoid cross threading or stripping of the threads from overtightening and ensure all fasteners are installed.
  - 2. Ensure all test forms and field data sheets are properly completed with all data entered correctly. Note all corrective actions taken, deficiencies found and recommendations, as well as any general comments.
  - 3. Apply a test sticker that includes name of testing firm date and initials of technician on each protective relay, circuit breaker and switchgear vertical section door.
  - 4. Review and organize all test results into a report with cover that includes the project information and a table of contents.
  - 5. The diesel fuel tank shall be topped off after this work is completed. The tank level reading, from the Owner's fuel monitoring system, shall be taken before and

after completion of the preventative maintenance work on the 4.16kV main switchgear to determine the amount of fuel that must be replaced in the tank.

### **3.3 SERVICE ENTRANCE GROUNDING ROD TESTING**

- A. Test resistance to ground at all service entrance grounding rods using an AVO Biddle DET 2/2 Ground Tester, Catalog No. 250202 or approved equal using the "Fall of Potential Method" or other Designer approved testing method.
- B. Confirm all service entrance grounding electrode and main system bonding jumper connections are mechanically secure and measure and record the resistance of each connection.
- C. Provide written report of test results including date and time of testing, test equipment used, test equipment calibration date and the names of individuals performing the tests. Note all deficiencies and provide recommended actions for remediation of the deficiencies

**END OF SECTION 260115**

## **SECTION 260500 – COMMON WORK RESULTS FOR ELECTRICAL**

### **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 SCOPE**

- A. The requirements of this section are applicable to all work performed under Division 26 – Electrical.

#### **1.3 RELATED SECTIONS**

- A. Division 03 – Concrete

#### **1.4 COORDINATION**

- A. It is the intent of the Electrical Division of these Specifications that all electrical work specified herein be coordinated as required with the work of all other Divisions of the Specifications and Drawings so that all installations shall operate as designed.
- B. Provide a complete operational electrical system. Route conduit and install equipment to avoid conflicts with other trades and to enhance maintainability of system.
- C. All construction work shall be carried on in a manner so as not to interfere with operation of the Owner's facilities.
- D. The Owner intends to make continued use of existing facilities. Utilities and services to existing facilities shall not be interrupted without the Owner's approval as to the time and duration. The Owner will continue to occupy the existing facilities throughout the construction operations, and the Contractor shall so organize his work as to cause a minimum of interference with the normal routine activities of the facilities. All interruptions shall be scheduled at the convenience of the Owner.
- E. The Contractor shall coordinate his work so there shall be no prolonged interruptions of existing equipment and all interruptions of utilities must be scheduled with the Owner. In no case shall any utilities be left disconnected at the end of a work day or over the weekend.
- F. Any interruptions of any utilities either intentionally or accidentally shall not relieve the Contractor responsible from repairing and restoring the utility to normal service. Repairs and restoration shall be made before the workmen responsible for the repair and restoration leave the job on the day such interruptions occur.
- G. The Contractor's area for construction shall be as shown on the Drawings.
- H. The Contractor shall maintain access to the Owner's facilities during construction by keeping clear the drives in the construction area. Any blockage of the drives shall be scheduled with the Owner.
- I. This project will involve several contractors in addition to this Contractor. There may also be contractors not associated with this project working in the vicinity.

- J. This Contractor shall cooperate fully with the other contractors in the conduct of the work. Such cooperation with regard to work schedules, area of work, etc., is to be a normal part of this type of project and no extra compensation will be allowed for it.

## **1.5 DEFINITIONS**

- A. Concealed: Where the word “concealed” is used in conjunction with raceways, equipment, and the like, the word shall be understood to mean hidden from sight as in chases, furred spaces, or above suspended ceilings.
- B. Exposed: Where the word “exposed” is used, the word shall be understood to mean open to view.
- C. Provide: Where the word "provide" is used, in the Specifications or on the Drawings, it shall mean "furnish and install" unless otherwise noted or specified.
- D. Related Work: The sections referenced under RELATED SECTIONS shall be understood to include provisions which directly affect the work being specified in the section where RELATED SECTIONS occurs.
- E. Temporary Generator: A Contractor furnished, trailer mounted diesel-engine-driven generator that is connected to provide power to the building power distribution system when there will be an interruption of the normal power supply to a portion of the building that will exceed 4 hours. The size of this generator shall be as required based on the amount of electrical distribution equipment affected by the power outage. The minimum size temporary generator for a power outage affecting the Ameren Missouri utility supply to the 4.16kV service entrance switchgear shall be 750 kW.
- F. Temporary Emergency Generator: A Contractor furnished, trailer mounted diesel-engine-driven generator that is connected to the building life safety and critical loads emergency switchboard (MESB1) to provide auto-start emergency generator backup during the time the facility’s permanently installed emergency generator is out of service. The minimum size for the temporary emergency generator shall be 400 kW.
- G. The Work: Where the words “the Work” are used together, they shall be understood to mean the work under contract that is governed by these Specifications and the Drawings.

## **1.6 SUBMITTALS**

- A. The Contractor shall submit to the Designer for approval, prior to fabrication and in accordance with the procedures outlined in Section 013300 – Submittals, all submittals as required by each Section in this Division of these Specifications.
- B. Each submittal shall be properly identified as to the specific equipment to which it relates. Identification on the submittal shall be by reference to equipment identification numbers as shown on the Drawings and, if applicable, by reference to the appropriate Article of the Specifications in which the equipment is specified.
- C. Shop drawings, brochures, or manufacturer's product data sheets showing more than one size or model shall be marked to indicate the size or model proposed for the particular application.
- D. All submittals shall be certified by the Contractor as being correct for the proposed work.

- E. Submittals in the form of shop drawings shall include complete data on the equipment to be provided, including physical dimensions and other information required for installation, performance capabilities and limitations, and schedules indicating locations when more than one type of an item is to be used.
- F. Prior to submittal, shop drawings shall be coordinated with the work of all other trades.
- G. Any and all submittals that do not comply with all of the above requirements will be rejected and returned without review.
- H. Provide operating instructions and maintenance manuals in accordance with Section 013300 – Submittals, Section 007213 – General Conditions and 007300 – Supplementary Conditions.

## **1.7 RECORD (AS-BUILT) DRAWINGS**

- A. The Contractor shall update a complete set of the construction drawings, shop drawings and schedules of all work daily 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 in accordance with Section 007213 – General Conditions. 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 or structures. All concealed items both inside and outside shall be accurately located 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.
- B. No deviations from the Contract Drawings or approved shop drawings shall be made without prior approval from the Designer or Construction Representative.

## **1.8 REFERENCE STANDARDS**

- A. Included as a basic part of these Specifications are the applicable regulations of the standards listed below. Portions of all of certain recognized industry or association standards referred to herein as being a requirement of these Specifications shall be considered as binding as though reproduced in full herein. Unless otherwise stated, the reference standard shall be the latest edition of the standard which is current as of the date of issuance of the Contract Documents. Where conflicts exist from one code to another, the more stringent requirement shall apply.
- B. Referenced Codes and Standards constitute minimum requirements and strict compliance is required therewith unless supplemented and/or modified by more stringent requirements in these Specifications.
- C. Reference may be made to standards either by full name or by letter designation as follows:
  - 1. ACI American Concrete Institute
  - 2. AHDGA American Hot Dip Galvanizers Association, Inc.
  - 3. AISC American Institute of Steel Construction
  - 4. ANSI American National Standards Institute
  - 5. ASA American Standards Association

|     |      |  |
|-----|------|--|
| 6.  | ASTM | American Society for Testing & Materials   |
| 7.  | AWS  | American Welding Society   |
| 8.  | BOCA | Building Officials and Code Administrators International, Inc.                                 |
| 9.  | CSA  | Canadian Standards Association   |
| 10. | EEI  | Edison Electric Institute  |
| 11. | EIA  | Electronics Industries Association   |
| 12. | ETL  | Electrical Testing Laboratories, Inc.  |
| 13. | FMRC | Factory Mutual Research Corp   |
| 14. | IACS | International Annealed Copper Standard   |
| 15. | IBC  | International Building Code  |
| 16. | IBEW | International Brotherhood of Electrical Workers  |
| 17. | ICC  | International Code Council   |
| 18. | ICEA | Insulated Cable Engineers Association  |
| 19. | IEC  | International Electrotechnical Commission  |
| 20. | IEEE | Institute of Electrical and Electronics Engineer   |
| 21. | IFC  | International Fire Code  |
| 22. | ISA  | The Instrumentation, Systems, and Automation Society   |
| 23. | JIC  | Joint Industrial Council   |
| 24. | NBFU | National Board of Fire Underwriters  |
| 25. | NEC  | National Electrical Code (NFPA 70)   |
| 26. | NECA | National Electrical Contractors Association  |
| 27. | NEMA | National Electrical Manufacturers Association  |
| 28. | NESC | National Electrical Safety Code  |
| 29. | NETA | InterNational Electrical Testing Association   |
| 30. | NFPA | National Fire Protection Association   |
| 31. | NIST | National Institute of Standards and Technology<br>(formerly National Bureau of Standards, NBS) |
| 32. | OSHA | Occupational Safety and Health Administration  |
| 33. | UL   | Underwriters' Laboratories, Inc.   |

## **1.9 REGULATORY LAWS, ORDINANCES, CODES AND STANDARDS**

- A. The governing federal, state, and local laws, codes and standards in effect at the project site constitute the minimum requirements for all electrical work, and strict compliance therewith is required unless supplemented and/or modified by more stringent requirements of the Contract Documents.
- B. All work under this Contract shall be performed in full compliance with the 2020 edition of the National Electrical Code (NEC) NFPA-70 and the latest edition of the National Electrical Safety Code (ANSI C2).

- C. The Contractor shall keep a copy of the 2020 NEC on the project site for his reference at all times.
- D. Requirements in reference specifications and standards are a minimum for equipment, material, and work. In instances where capacities, size, or other features of equipment, devices, or materials exceed these minimums, meet specified or scheduled capacities.
- E. Resolve code interpretations discovered in Contract Documents with Designer prior to Contract award. After Contract award, make corrections or additions necessary for compliance with applicable codes.

#### **1.10 CONTRACT DRAWINGS**

- A. Included under Section 000115 – List of Drawings of these Specifications are the Drawings which indicate in general the character, arrangement, and construction of equipment and materials called for in these Specifications.
- B. Drawings are generally diagrammatic and are intended to encompass a system that will not interfere with other systems or the structural and architectural design of the building or related structures. Coordinate work to avoid interferences with other systems or between conduit, piping, and equipment or with architectural or structural elements of the building or related structures.
- C. Drawings are based on preliminary information obtained from a manufacturer of the equipment specified. Make adjustments, modifications, or changes required, based on the shop drawings furnished by the manufacturer of the equipment to be furnished on this project.

#### **1.11 WORKMANSHIP**

- A. All work shall be done under the supervision of the Contractor who shall provide competent foremen to lay out all work. All work shall be laid out with due regard for proper working clearances about electrical equipment in accordance with NEC Article 110 and the space requirements of other contractors. The Contractor shall immediately report to the Construction Representative any conflict or difficulties with regard to the installation.
- B. The Contractor shall be completely responsible for all work installed by him and shall employ only competent and experienced personnel of proper trades to perform the work.
- C. All work shall be installed so as to be accessible for operation, maintenance, adjustment, replacement, and repair with particular attention given to locating controls and other items requiring periodic lubrication, cleaning, adjusting, or servicing of any kind.
- D. Local disconnect switches, control stations, conduit drops, control panels, electrical enclosures, instrumentation, etc. shall be located so as not to interfere with access required for the necessary service and operation of equipment and shall meet the working clearance requirements of Article 110 of the National Electrical Code.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS AND EQUIPMENT**

- A. Only NEW, clean and perfect equipment, apparatus, materials, and supplies of latest design and manufacture shall be incorporated in the work in order to assure an electrical system of high quality.
- B. All materials shall be new, shall be installed according to manufacturer's specifications or as directed by the Designer, and shall be listed and labeled by Underwriters' Laboratories, Inc. (UL) or other nationally recognized testing laboratory (NRTL).
- C. All materials and equipment furnished under these Specifications shall be standard products of the various manufacturers except where special construction or performance features are called for. Where more than one of the specific items is required, all shall be of the same type and by the same manufacturer.
- D. The product of a manufacturer shall be acceptable only when that product complies with or is modified as necessary to comply with all specified and indicated requirements in the Contract Documents.
- E. Materials and equipment not herein specified or indicated as to manufacturer but necessary for complete functioning systems shall be provided from sources conforming to the quality levels and functional requirements for corresponding materials and equipment set forth herein.
- F. Material or equipment damaged, shown to be defective or not in accordance with the Specifications shall be repaired or replaced by the Contractor to the full satisfaction of the Construction Representative.

### **2.2 MANUFACTURER'S EQUIPMENT NAMEPLATES**

- A. All equipment shall have factory applied permanent nameplates indicating the manufacturer's name, model and serial numbers, and any other data necessary to conform to specified requirements.

### **2.3 EQUIPMENT PADS AND ANCHOR BOLTS**

- A. Concrete equipment pads shall be provided for all indoor floor-mounted and outdoor grade-mounted electrical equipment.
- B. The size and configuration of the equipment pad(s) and anchor bolt or other fastening requirements shall coordinate with and shall be suitable for the equipment to be installed. The Contractor shall be responsible for coordinating all requirements prior to forming and pouring the concrete.
- C. All concrete work shall conform to the requirements of Division 03 of these Specifications.
- D. Unless otherwise indicated, indoor equipment pads shall be 2 inches larger all around and outdoor equipment pads shall be 6 inches larger all around than the equipment base. All equipment pads shall have a 1-inch chamfer all around the top edge.
- E. Equipment pads shall be poured level and shall have a smooth finish.



- F. Unless otherwise indicated, equipment pads located indoors shall be 3-1/2 inches above finished floor and equipment pads located outdoors shall be 5-1/2 inches above finished grade.
- G. Equipment pads shall have size 4 reinforcing steel rods placed 12 inches on center each direction, midway between the top and bottom of the pad.
- H. Unless otherwise indicated, all equipment shall be properly anchored to the outdoor equipment pad, or the concrete floor beneath the indoor equipment pad, using an approved means of fastening, meeting all seismic requirements of the International Building Code (latest edition).
- I. Anchor bolts shall be provided where necessary and shall be type 304 or 316 stainless steel outdoors or galvanized steel indoors. Installation of anchor bolts shall be in accordance with Section 260529 – Hangers and Supports for Electrical Equipment.

## **2.4 PAINTING AND FINISHES**

- A. All purchased equipment shall have a factory applied standard finish of the manufacturer's standard color unless otherwise specified.
- B. Finishes which are marred during shipping, handling, or installation shall be touched up by the Contractor to match the original finish.

## **2.5 EQUIPMENT TAGGING**

- A. All equipment and materials shipped under these Specifications shall be properly tagged with the name of the item, name of the project and project address, and shall bear the Contractor's name.

# **PART 3 - EXECUTION**

## **3.1 SCOPE OF THE WORK**

- A. The Contractor shall provide all labor, materials, equipment, tools, supervision, and services required for the complete installation of all electrical work as shown on the Drawings and described in these Specifications.
- B. The work under Divisions 26 of the Specifications includes, but is not limited to, the following items:
  - 1. Preventative maintenance on existing outdoor 4.16 kV main switchgear and outdoor metal-enclosed 4.16 kV automatic transfer switchgear.  
Alternate Bid No. 3
  - 2. Demolition of existing panelboards, outdoor diesel-engine-driven generator and automatic transfer switches.
  - 3. Demolition of existing power and branch circuit conductors, cables, raceways, boxes, and equipment
  - 4. Demolition of existing control conductors, cables, raceways, boxes, and devices
  - 5. Disposal off site of the existing equipment and materials to be removed

6. Disconnection, handling, relocation and/or reconnection of existing equipment and electric power and rerouting of existing power and control circuits as required and as shown on the Drawings
  7. Trenching, excavating and backfilling for underground raceways
  8. Underground conduits
  9. All feeder and branch circuit wiring and raceways
  10. All control conductors, cables, raceways, boxes and devices
  11. Grounding and bonding
  12. Junction and pull boxes
  13. Protective device coordination study and arc flash risk assessment
  14. Concrete equipment pads
  15. Generator power distribution switchboard
  16. Wiring devices and cover plates
  17. Fuses and circuit breakers
  18. All motor power and control circuit wiring, raceways, equipment and components
  19. Diesel-engine-driven generator set and all associated components
    - a. Alternate Bid No. 2: Radiator mounted resistive load bank
  20. Generator connection cabinet
  21. Automatic transfer switches
    - b. Base Bid: Open Transition
    - c. Alternate Bid No. 1: Closed Transition
- C. The Contractor shall furnish and install all control and power wiring required to properly operate the new packaged engine generator system including all control/annunciator panels. It may become necessary to modify the interconnecting control wiring from that shown on the Drawings in order to accommodate the control system diagrams provided by the manufacturers of the systems. To this extent, the Contractor shall make all such accommodations at no additional cost to the Owner.

### **3.2 SHIPMENT AND DELIVERY**

- A. The Contractor shall be responsible for the furnishing and safe delivery of all materials and equipment required for the project and for the safekeeping of all material and equipment until final acceptance by the Construction Representative.
- B. The Contractor shall be responsible for protecting all electrical equipment intended exclusively to function indoors. Such equipment must be stored indoors and protected against exposure to or accumulation of dust, moisture, freezing, flooding, corrosion or other form of damage. The Contractor shall clean and restore damaged finishes as required to place the installation in a "like new" condition before acceptance by the Owner.

### **3.3 SAFETY MEASURES**

- A. The Contractor shall arrange his work in such a manner that a minimum of interference will be experienced with the operations of the Owner or with traffic, both pedestrian or vehicular, either in the vicinity of or on the project site.
- B. The blocking of thoroughfares shall be kept to a minimum and shall be coordinated with the Construction Representative and authorities have jurisdiction.
- C. The Contractor shall comply with the U.S. Department of Labor-Occupational Safety and Health Administration (OSHA) - Occupational Safety and Health Standards, all local and state public safety regulations and provide such safety measures as signs, signals, road blocks, safety lights, railings, guards, temporary walkways, crossings and similar safety equipment as may be required for the adequate protection of the public, the Owner's personnel, workmen engaged on the project, and property.

### **3.4 WORK VERIFICATION AND FIELD MEASUREMENTS**

- A. The Contractor shall verify the voltage, phase, full-load current and exact location of all electrical equipment before rough-in.
- B. The Contractor shall note that the configuration and dimensions of actual equipment may vary from that shown on the Drawings depending on the equipment supplied. The Contractor shall be responsible for making the necessary modifications to connecting conduit, bases, etc. required by the equipment supplied.
- C. All dimensions and clearances affecting the installation of work shall be verified at the project site in relation to established datum, to existing items and conditions, and to the work of other trades.
- D. The Contractor shall assume responsibility for proper installation of materials in the space available.
- E. The location of all equipment and systems shall be coordinated to preclude interferences with other construction.
- F. Should interferences occur which will necessitate deviations from layout or dimensions shown on the Drawings, the Construction Representative and/or Designer shall be notified, and any changes shall be approved before proceeding with the Work.
- G. Where crowded locations exist and where there is a possibility of conflict between the trades, the Contractor shall make composite drawings showing the exact locations of the items in question (pipes, ducts, conduits, equipment, etc.). Drawings shall be based on actual measurements, after consultation and agreement between the trades, and shall be approved by the Designer before installation of the Work.
- H. The Contractor shall provide all necessary offsets, raises or drops in conduits and fixtures as required by existing conditions at no additional cost to the Owner.
- I. The location of all items shall be obtained from the Drawings. The Construction Representative and/or the Designer shall be allowed to relocate any item within a 10-foot radius from the scaled location on the plans without additional cost to the Owner, provided this is done prior to or during rough-in and before finish installation.

### **3.5 ELECTRICAL WORK DEMOLITION AND RELOCATION OF EXISTING EQUIPMENT**

- A. See Section 260505 – Selective Demolition for Electrical in these Specifications.

### **3.6 MOUNTING HEIGHTS**

- A. Unless otherwise indicated elsewhere in these Specifications or Drawings, mounting heights of wiring devices and equipment shall be in accordance with the following schedule.
- B. The following item mounting heights shall be above finish floor/work platform to the horizontal centerline of the item.

| <u>Item</u>   | <u>Mounting Height</u> |
|---|------------------------|
| 1. Toggle switches  | 4 feet 0 inches        |
| 2. Receptacles (indoors)  | 4 feet 0 inches        |
| 3. Control stations, selector switches and push button controls | 4 feet 0 inches        |

- C. The following item mounting heights shall be above finish floor/work platform to the top of the item.

| <u>Item</u>                            | <u>Mounting Height</u> |
|--|------------------------|
| 1. Panelboards (less than 5'-8½" high) | 6 feet 0 inches        |
| 2. Enclosed Circuit Breakers           | 6 feet 0 inches        |
| 3. ATs (less than 5'-8½" high)         | 6 feet 0 inches        |
| 4. Control panels                      |                        |
| a. 36" high or less                    | 5 feet 6 inches        |
| b. Greater than 36" high               | 6 feet 0 inches        |

- D. Any item 5 feet 8-1/2 inches high and larger shall be floor mounted on a 3-1/2 inch high concrete equipment pad (for indoor locations) or a 5-1/2 inch high concrete equipment pad (for outdoor locations), unless otherwise indicated.

### **3.7 FASTENING TO BUILDING STRUCTURES**

- A. The methods of attaching or fastening equipment, equipment supports, raceways, or hangers to building structures shall be subject to approval by the Construction Representative at all times.
- B. Support of electrical equipment and raceways shall be provided in accordance with Section 260529 – Hangers and Supports for Electrical Equipment.

### **3.8 CUTTING, PATCHING AND REPAIRING**

- A. The Contractor shall be responsible for all cutting required for and resulting from the installation of his work, except where noted otherwise. The Contractor shall patch and repair the holes and restore the surface finish.

- B. The Contractor shall place sleeves for conduits that must pass through foundations, walls, and slabs ahead of concrete pouring. Failing in this, the Contractor shall do the necessary cutting and sealing thereafter in an approved manner.
- C. Under no circumstances shall any structural members, load bearing walls, building columns or footings be cut without first obtaining written permission from the Designer.
- D. Cutting shall be in accordance with the following.
  - 1. Concrete and Masonry: All openings for conduit shall be core drilled. Square or rectangular openings shall be saw cut.
- E. Patching shall be in accordance with the following.
  - 1. Non-fire Rated Concrete and Masonry: Patch the opening with Sika Top 122 Plus (Sika Corp.) non-shrink grout or approved equal, finished smooth with adjacent surface.
  - 2. Fire-rated Construction: In accordance with Section 260533.13 – Conduit for Electrical Systems.

### 3.9 ELECTRICAL TESTS

- A. The Contractor shall, after the installation is completed, visually inspect all items to ascertain that each item is not damaged and is in proper working condition, and shall test all circuits and demonstrate to the satisfaction of the Construction Representative and/or Designer, the following:
  - 1. That all power and control circuits are continuous and free from short circuits and unspecified grounds.
  - 2. That the resistance to ground of all ungrounded circuits operating below 600 volts is 50 megohms or greater at a test voltage of 1000 VDC.
  - 3. That all circuits are properly connected to the correct phase and in accordance with the Drawings and applicable wiring diagrams. Circuits shall be numbered as shown on the Drawings and connected to equalize the loading on all phases.
  - 4. That all circuits and equipment are operable. Demonstration shall include the proper functioning and operation of each unit to the Owner's satisfaction, and the continuous operation of all power circuits for not less than 24 hours.
  - 5. That all equipment requiring calibration and adjustment has been properly calibrated and adjusted in accordance with its intended function and the manufacturer's recommendations.
  - 6. That all equipment and systems function properly.
  - 7. That the phasing sequence and synchronization is the same throughout the entire electrical system. The Contractor shall be responsible for the correct phase rotation on all motors and devices. Any item that is damaged as a result of improper rotation or phasing shall be replaced by the Contractor at no additional cost to the Owner.
- B. Perform testing in accordance with the requirements of each of the following sections of this Division of the Specifications:
  - 1. Section 260115 – Preventative Maintenance for 4.16 kV Electrical Equipment
  - 2. Section 260526 – Bonding and Grounding for Electrical Systems

3. Section 262413 – Switchboards
  4. Section 262416 – Panelboards
  5. Section 263213.13 – Diesel-Engine-Driven Generator Set
  6. Section 263236 – Resistive Load Bank (Alternate Bid No. 2)
  7. Section 263623 – Automatic Transfer Switches, Open Transition
  8. Section 263623.13 – Automatic Transfer Switches, Closed Transition (Alternate Bid No. 1)
  9. Section 263623.16 – Automatic Transfer Switch for Fire Pump
- C. All tests shall be made after notification to and in the presence of the Construction Representative and/or Designer and the authorities having jurisdiction, if required.
- D. The cost of labor, materials, instruments and supplies of any kind required for testing shall be borne by the Contractor.
- E. Before starting up any system, each piece of equipment comprising a part of the system shall be checked for proper lubrication, drive rotation, continuity of controls, and any other condition which could cause damage to equipment or endanger personnel.
- F. Test runs shall be made over the full design load range where possible, or simulated to the satisfaction of the Construction Representative for other conditions. During test runs all necessary adjustments shall be made, controls checked for proper operation, motors checked for possible overload, and the entire system checked by the Contractor for any abnormal condition.
- G. During the test runs and prior to acceptance of any system, the Owner's designated operating personnel shall be instructed in the operation and maintenance of the system.
- H. Material and equipment damaged or shown to be defective during tests, unable to perform at design or rated capacity, or not in accordance with the Specifications shall be repaired or replaced by the Contractor to the full satisfaction of the Construction Representative at no cost to the Owner.

### **3.10 START UP**

- A. All systems shall be completely assembled, tested, adjusted and demonstrated to be ready for operation to the satisfaction of the Construction Representative.
- B. The Contractor shall provide qualified personnel to perform start up assistance and final acceptance testing of all equipment after it has been completely installed and is ready to be energized, prior to applying voltage.
- C. The Contractor shall be responsible for the operation and maintenance, including all costs thereof, for systems or equipment temporarily placed in operation for testing and adjusting purposes, or for the convenience or necessity of the Contractor prior to final acceptance by the Owner.
- D. The Contractor shall instruct the Owner's operating personnel in the operation and maintenance of the electrical equipment during energization but prior to acceptance by the Owner.

### **3.11 TEMPORARY POWER**

- A. The St. Louis Forensic Treatment Center - South is a 24/7/365 TJC accredited 180-bed psychiatric hospital and as such, requires that electrical power be maintained during the execution of the work specified in the plans and these specifications.
- B. The Work will require interruptions of the primary incoming 4.16 kV power to the facility to allow preventative maintenance to be performed on the 4.16 kV main switchgear in accordance with Section 260115 – Preventative Maintenance for 4.16kV Electrical Equipment under Alternate Bid No. 3. This work shall not be completed until after the new 1000 kW standby-duty rated diesel-engine-driven generator has been installed and is fully functional such that the new generator can power the facility during the utility power outage that will be required to complete the preventative maintenance work.
- C. Power outages shall be coordinated with the Construction Representative and are weather dependent. Contractor shall notify Construction Representative two (2) weeks in advance of desired outage time. Construction Representative will give Contractor 72 hours advance notice of actual time for outage.
- D. Provide a temporary diesel-engine-driven generator for any power outage longer than 4 hours that affects fire protection, fire alarm, dedicated telephone or emergency management systems to avoid the Owner from having to conduct fire watches.
- E. Provide a temporary standby emergency generator, having a minimum full load output rating of at least 500kW, to provide emergency backup power to the facility during the maximum 20 working day time-period the existing 600kW emergency generator is being replaced with the new 1000kW emergency generator per the notes on Drawing G-003.
- F. The Contractor shall be responsible for furnishing the temporary generator(s) along with cables and all other items required to connect the generator(s) to the building power system equipment.
- G. Routing of temporary cables from temporary generator(s) and means of connection to existing electrical equipment shall be subject to Construction Representative's approval.
- H. The temporary generator(s) shall be in good, reliable condition, less than five years old, and subject to the approval of Construction Representative.
- I. Contractor shall be solely responsible for maintaining and servicing the temporary generator during the construction period including all fuel, oil, filters, etc.
- J. Use of a temporary generator to power the facility, or any portion of the facility, shall be limited to normal working hours, Monday through Friday, excluding holidays observed by the State of Missouri. If an after-hours power outage is deemed by the Contractor to be unavoidable he must petition the Construction Representative for approval a minimum of 72 hours in advance.
- K. The Contractor shall have a person knowledgeable in the operation of the temporary generator on site at all times when one or more temporary generators is/are in operation.

### **END OF SECTION 260500**

## **SECTION 260505 – SELECTIVE DEMOLITION FOR ELECTRICAL**

### **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 SCOPE**

- A. This Section includes demolition and removal of selected portions of facility required for new construction.

#### **1.3 DESCRIPTION OF WORK**

- A. Furnish all materials, labor, equipment and services necessary to perform all electrical demolition work.
- B. Work included in this Section includes all demolition work as shown on the Electrical Drawings and as specified herein and as required to complete the Work.

#### **1.4 RELATED SECTIONS**

- A. Section 024119 – Selective Demolition
- B. Section 230505 – Selective Demolition for HVAC
- C. Section 260500 – Common Work Results for Electrical

#### **1.5 DEFINITIONS**

- A. Demolish: Completely remove and legally dispose of off-site.
- B. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.
- C. Recycle: Recovery of demolition waste for subsequent processing in preparation for reuse.
- D. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.
- E. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.
- F. Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner. Include fasteners or brackets needed for reattachment elsewhere.

#### **1.6 SUBMITTALS**

- A. Schedule of Selective Electrical Demolition Activities: Indicate detailed sequence of selective electrical demolition and removal work, with starting and ending dates for each activity and interruption of electric power services.

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- B. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition.
- C. Predemolition Photographs: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by selective electrical demolition operations. Submit before the Work begins.
- D. Disposal Records: If hazardous wastes are removed by Contractor, submit the following:
  - 1. Hazardous Waste Transporter license
  - 2. Permit or license for hazardous waste treatment or disposal facilities
  - 3. Completed Uniform Hazardous Waste Manifest for all shipments
  - 4. Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

## **1.7 QUALITY ASSURANCE**

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI A10.6 and NFPA 241, latest editions.
- C. Prior to beginning demolition, arrange a conference with the Construction Representative to review electrical demolition scope, procedures, schedule and items to be salvaged for the Owner.

## **1.8 PROJECT CONDITIONS**

- A. Owner will occupy the facility during construction. Localized areas to be demolished will be vacated during demolition work. Conduct selective electrical demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Construction Representative of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: The Owner is not aware of the presence of any hazardous materials in the interior of the building to be selectively demolished.
  - 1. If materials suspected of containing hazardous materials are encountered, do not disturb. Immediately notify Designer and Construction Representative.
  - 2. Hazardous material remediation will be completed as a portion of this contract. This work is anticipated to be sequenced with the proposed phasing of construction activities.
- E. Utility Service: Maintain electrical service to building during selective electrical demolition operations.
  - 1. Disconnect electrical power only to the items of equipment or the panelboard that is identified for removal under the selective electrical demolition operations.

## **1.9 WARRANTY**

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

## **1.10 MATERIALS OWNERSHIP**

- A. Except for items or materials to be reused, salvaged, reinstalled or otherwise indicated to remain the Owner's property, demolished materials shall become the Contractor's property and shall be removed from the site with further disposition at the Contractor's option but in compliance with ordinances and regulations related to the materials being disposed.

## **1.11 COORDINATION**

- A. Arrange demolition schedule so as not to interfere with Owner's on-site operations and the operations of adjacent occupied buildings.
- B. Review and finalize selective electrical demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
- C. Review requirements of General Demolition Contractor and work performed by other trades that rely on demolition of electrical circuitry or equipment to allow for structural demolition or removal of equipment.
- D. Review areas where existing electrical circuitry and/or equipment is to remain in place and requires protection.

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

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION & RECORDING OF CONDITIONS**

- A. Verify that utilities have been disconnected and capped before starting selective electrical demolition operations.
- B. Survey existing conditions and coordinate and identify the extent of the electrical demolition work required. Record existing conditions using preconstruction photographs.
- C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged. Use photographs to document conditions.
- D. When unanticipated site, mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Construction Representative and Designer.
- E. Perform surveys as the work progresses to detect hazards resulting from the execution of the work.

### 3.2 COORDINATION

- A. No electrical demolition work shall be performed without prior approval of the Construction Representative.
- B. Electrical demolition work shall be carried on in a manner so as not to interfere with operation of the Owner's facilities.
- C. Any electrical demolition work which interferes with Owner's operation shall be scheduled with the Construction Representative and be subject to the Owner's approval.
- D. Maintain existing services required to avert disruption to the Owner's on-going operations and protect them against damage during the performance of the work.
- E. Do not interrupt existing electrical service to occupied facilities except when authorized in writing by the Construction Representative.
- F. Provide temporary electrical service during interruptions to existing electrical systems, as acceptable to the Construction Representative.
- G. Unless noted otherwise, provide not less than two weeks' notice to the Owner if shutdown of electrical service is required during the execution of the work.
- H. The Contractor shall not remove any material beyond the limits indicated on the Drawings unless given permission to do so by the Construction Representative. Any such material removed shall be replaced by the Contractor at his expense. If the items removed are damaged and/or cannot be satisfactorily reinstalled, new material of like construction shall be furnished and installed by the Contractor at his expense.
- I. All damages to buildings and utilities to remain in place shall be promptly repaired at no cost to the Owner. Repairs and restoration of accidental utility interruptions shall be made before the workers responsible for the repair and restoration leave the job on the day such interruptions occur.

### 3.3 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective electrical demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
- C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
- D. Existing building openings may be used to remove material. No new openings may be made without approval of the Construction Representative.

### **3.4 PROTECTION**

- A. Comply with governing laws, codes, and regulations governing fire protection and environmental protection during electrical demolition operations.
- B. Provide dust control and ventilation as required in areas of electrical demolition.
- C. Execute electrical demolition work, so as to insure adjacent areas against damage which might occur from falling debris or other causes; do not interfere with the use of, operations in, or around adjacent areas; maintain free and safe passage of persons around the areas of electrical demolition.
- D. Provide temporary handrail, barricades, floor plates, etc. as required to provide protection for open elevated platforms, holes, etc. created by the electrical demolition work.
- E. Premises shall be maintained and protected from all unsafe or hazardous conditions at all times.
- F. Protect existing surfaces, active utility services, and equipment which are to remain in place.
- G. Protect lighting fixtures, exit signs, fire alarm devices, and other items that are to remain in place from damage during demolition and construction operations. Exposed fixtures and devices shall have a plastic bag or other suitable covering affixed over the item to protect from dust and paint splatters.

### **3.5 DUST CONTROL**

- A. Contractor shall use temporary enclosures and other suitable methods as necessary to limit the amount of dust and dirt carrying over to other parts of the Owner's property.
- B. Adequacy of the dust control methods shall be subject to the approval of the Construction Representative.
- C. Areas of major electrical demolition inside the Owner's property shall be enclosed by means of temporary walls constructed of wood framing with plywood or 6 mil polyethylene sheets.
- D. Temporary enclosures shall be removed by the Contractor upon completion of the electrical demolition work unless otherwise directed by the Construction Representative.

### **3.6 ELECTRICAL DEMOLITION - GENERAL**

- A. Remove all work indicated on the Drawings and as required to complete the new work indicated.
- B. During electrical demolition operations, keep areas adjacent to electrical demolition work free of dust and debris.
- C. During electrical demolition operations, if suspected hazardous materials or conditions are uncovered, stop work in that area, and inform the Construction Representative.
- D. At concealed spaces, such as hollow walls, ducts, and pipe interiors, verify condition and contents of hidden space before starting electrical demolition operations.
- E. Neatly cut openings and holes plumb, square and true to dimensions, required.

- F. Use cutting methods least likely to damage construction to remain or adjoining construction.
- G. To minimize disturbance of adjacent surfaces, use hand or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
- H. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
- I. Do not use cutting torches until work area is cleared of flammable materials.
- J. Maintain portable fire-suppression devices during flame-cutting operations.
- K. Contractor shall take care when using a torch to cut steel welded or bolted to structural members so as to cut flush with but not damage the structural members.
- L. All hanger and support material for demolished piping and conduit shall be removed back to the primary structural support member. Grind connection to primary member smooth and touch up with paint to match adjacent surface.
- M. All elevated equipment and materials to be demolished shall be carefully lowered (not dropped) by means of temporary riggings. Contractor shall not overload any elements of existing structure during the rigging operation.
- N. Locate selective electrical demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
- O. Dispose of demolished items and materials promptly.

### **3.7 ELECTRICAL DEMOLITION**

- A. Protect existing electrical equipment and installations indicated to remain. If damaged or disturbed in the course of the Work, remove damaged portions and install new products of equal capacity, quality and functionality.
- B. The Contractor shall use caution in the demolition of electrical systems and shall inform himself of the status (active, inactive) of all electrical systems to be demolished prior to proceeding.
- C. Prior to breaking or cutting conduit within the demolition area, the Contractor shall ascertain that the system has been identified or shown on the Drawings to be wrecked under this Contract. Contact the Construction Representative for clarification prior to demolishing or wrecking questionable items.
- D. The Contractor shall remove, cap and/or relocate equipment, outlets, lighting fixtures, conduit, cables, wire, etc., as specified or as shown on the Drawings and as may become necessary because of existing field conditions at no additional cost to Owner.
- E. All existing lighting fixtures, switches, receptacles, outlets, etc., shall be removed as required to complete the work and blank covers provided over the outlets, unless otherwise noted.
- F. Properly dispose of all lighting fixture lamps and ballasts in accordance with all applicable Federal, State, and local laws and regulations.

- G. All concealed conduit for circuits which are partially or completely abandoned may remain in place. Remove all wiring for concealed circuits that are to be completely abandoned and cut and remove concealed conduit 2 inches below the surface of adjacent construction. Cap conduits and patch surface to match existing finish and fire rating. Exposed conduit for abandoned circuits shall be removed, unless otherwise noted.
- H. Exposed conduit containing circuits which are to be retained shall remain in place, unless otherwise indicated or required.
- I. Wiring for existing circuits which must be rerouted, or which are partially abandoned, shall be reconnected to service the outlets/loads remaining on the circuit.
- J. All wiring for a circuit which is to be removed or abandoned shall be removed back to the panel which supplied the circuit.
- K. Completely remove all hangers and supports to building structure. Grind off stubs without damaging parent material (steel, concrete, etc.) and touch up paint as required.
- L. All abandoned or remaining empty conduit with open ends resulting from demolition work shall be promptly capped, plugged, or sealed.
- M. All open conduit knockouts, holes, or unused hubs in electrical boxes and enclosures shall be properly plugged with suitable blanking devices of the same material as the enclosure that maintain the NEMA rating of the enclosure. Utilize NEMA 12 rated hole seal devices to seal all open holes in the top of all panelboards, switchboards, switchgear, motor control centers, and dimensioned junction and pull boxes located indoors.

### **3.8 CONCRETE AND MASONRY DEMOLITION**

- A. Demolish concrete and masonry in small sections.
- B. Cut concrete and masonry at junctures with construction to remain, using power driven masonry saw or hand tools. Do not use power-driven impact tools.

### **3.9 PATCHING**

- A. All holes or openings in floors, walls or ceilings resulting from electrical demolition shall be properly sealed with material similar to the adjacent surface/finish. Patch holes in concrete floors and ceilings where conduits are removed using non-shrink epoxy grout or concrete material to match existing surfaces and construction. Patch holes in walls and partitions where conduits are removed to match existing construction and finish.
- B. All rough edges of openings created by electrical demolition shall be promptly patched to create a finished surface.
- C. Openings in concrete shall be patched with cement mortar.
- D. Openings in masonry shall be patched by toothing in masonry units to match existing.
- E. Maintain the fire rating of all floors, walls, partitions and ceilings when patching.

### **3.10 REMOVED AND SALVAGED ITEMS**

- A. Carefully remove and clean salvaged items.

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- B. Pack or crate items after cleaning. Identify contents of containers.
- C. Store items in a secure area until delivery to Owner.
- D. Transport items to Owner's storage area as directed by Construction Representative.
- E. Protect items from damage during transport and storage.
- F. The following items are to be salvaged after removal, cleaned and crated as indicated above, and loaded onto a trailer to be provided by the Owner at the project site:
  - 1. Existing diesel-engine-driven generator set, including weatherproof enclosure, access stairs and platform, structural steel base rails and all items within the generator set weatherproof enclosure.
  - 2. Existing ATS-1 (for fire pump)
  - 3. Existing ATS-4 (150A with bypass)

### **3.11 REMOVED AND REINSTALLED ITEMS**

- A. Carefully remove items to be reinstalled.
- B. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
- C. Pack or crate items after cleaning and repairing. Identify contents of containers.
- D. Protect items from damage during transport and storage.
- E. Reinstall items in locations indicated.
- F. Comply with installation requirements for new materials and equipment.
- G. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- H. If the items removed are damaged and/or cannot be satisfactorily reinstalled, new material of like construction shall be furnished and installed by the Contractor at his expense.

### **3.12 EXISTING ITEMS TO REMAIN**

- A. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective electrical demolition.
- B. When permitted by Construction Representative, items may be removed to a suitable, protected storage location during selective electrical demolition and reinstalled in their original locations after selective electrical demolition operations are complete.

### **3.13 DISPOSAL**

- A. All debris resulting from electrical demolition operations shall become the property of the Contractor and shall be removed daily from the Owner's property unless otherwise permitted by the Construction Representative.

- B. Storage of removed materials on site will not be permitted.
- C. The on-site sale of removed equipment and materials will not be permitted.
- D. Transport demolished materials off Owner's property and dispose of legally in accordance with Federal, State, and local laws and regulations.
- E. Upon completion of work, remove tools, materials, apparatus, and rubbish. Leave area clean, neat, and orderly.

### **3.14 CLEANING**

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective electrical demolition operations.
- B. Return adjacent areas to condition existing before selective electrical demolition operations began.

### **3.15 HAZARDOUS MATERIALS**

- A. The Owner, to the best of his knowledge, is not aware of the presence of any hazardous materials such as friable asbestos and/or lead based paint in the work areas.
- B. Should the Contractor discover material requiring removal which is suspected to contain hazardous materials, do not disturb.
- C. Contact and consult with the Construction Representative prior to proceeding. The Construction Representative shall direct the Contractor how to proceed.

**END OF SECTION 260505**



## **SECTION 260513 – MEDIUM-VOLTAGE CABLES**

### **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 the Work specified in this Section.

#### **1.2 SCOPE**

- A. Furnish and install all medium-voltage power cables and associated materials as specified herein and as shown on the Drawings.

#### **1.3 RELATED SECTIONS**

- A. Section 260500 – Common Work Results for Electrical
- B. Section 260526 – Grounding and Bonding for Electrical Systems
- C. Section 260533.13 – Conduit for Electrical Systems
- D. Section 260553 – Identification for Electrical Systems

#### **1.4 SUBMITTALS**

- A. Manufacturer's product data sheets shall be submitted for each of the following items:
  - 1. Medium-voltage power cable
  - 2. Cable termination kits
  - 3. Cable moisture seals
- B. Submit qualification data for medium-voltage cable splicer certifying adequate training and experience for the specific type of termination kits required for this project.
- C. Submit qualification data for medium-voltage cable HiPot testing technician certifying adequate training and experience for the successful performance of the testing required.
- D. Submit 5 kV cable preparatory test report prior to commencement of medium-voltage cable acceptance testing.
- E. Submit 5 kV cable acceptance test report.

### **PART 2 - PRODUCTS**

#### **2.1 GENERAL**

- A. All applicable requirements of Article 328 – Medium Voltage Cable of the 2020 edition of the National Electrical Code shall apply to this Section.
- B. Medium-voltage power cable (Type MV) shall be defined as single or multi-conductor solid dielectric insulated cable rated 2001 volts or higher, up to 35,000 volts.

- C. All medium-voltage cable, splices and terminations shall be insulated and rated for 5 kV.

## 2.2 MEDIUM-VOLTAGE POWER CABLE

- A. All cable which is to be used for medium-voltage systems shall be Underwriters' Laboratories, Inc. listed Type MV-105 single conductor shielded medium-voltage (MV) power cable having ethylene propylene rubber (EPR) insulation, rated 5 kV. Cable shall be rated to be installed in wet or dry locations, indoors or outdoors, in a raceway, in an underground duct or directly buried. The cable must be triple tandem extruded with an all ethylene propylene insulation system.
1. Conductor: Compact stranded per ASTM B-496, uncoated annealed copper per ICEA S-93-639/NEMA WC 74 Section 2, size 1/0 AWG unless indicated otherwise on the Drawings.
  2. Strand Shield: Extruded semi-conducting ethylene propylene rubber (EPR) with 100% EPR construction per ICEA S-93-639/NEMA WC 74 Section 3. The screen shall not contain any polyethylene.
  3. Insulation: Ozone and corona discharge resistant, thermosetting, ethylene propylene rubber (EPR) with 100% EPR construction per ICEA S-93-639/NEMA WC 74 Section 4. The insulation thickness shall be 115 mils for 133% insulation level per ICEA S-93-639/NEMA WC 74 Table 4-4. The minimum spot thickness shall not be less than 90% of the specified thickness. The insulation shall not contain any polyethylene.
  4. Insulation Shield: Extruded semi-conducting ethylene propylene rubber (EPR) with 100% EPR construction applied over the insulation per ICEA S-93-639/NEMA WC 74 Section 5. The insulation shield shall not contain any polyethylene.
  5. Shield: Bare uncoated 5 mil thick copper tape helically applied over the insulation shield with a 12.5% minimum overlap per ICEA S-93-639/NEMA WC 74 Section 6.
  6. Jacket: Black polyvinylchloride (PVC) per ICEA S-93-639/NEMA WC 74 Section 7 having the following minimum thickness:
    - a. 60 mils: 6 to 2/0 AWG
    - b. 80 mils: 3/0 AWG to 1000 KCM
  7. Temperature Ratings:
    - a. 105°C continuous operation, wet or dry locations
    - b. 140°C emergency overload
    - c. 250°C short circuit conditions
  8. Testing: All cables shall be tested in accordance with the applicable requirements of ICEA S-93-639/NEMA WC 74, AEIC CS8, and UL 1072.
  9. Certification: All cables shall be certified to be in conformance with all applicable requirements of ICEA S-93-639/NEMA WC 74, AEIC CS8, and UL 1072.
  10. Identification: Surface printing on the cable jacket shall show manufacturer's name, conductor size, conductor material, insulation type, jacket type, voltage rating, nominal insulation thickness, year of manufacturer, insulation level, and UL designations
  11. Manufacturer: Okonite, Prysmian, Southwire or approved equal

## 2.3 CABLE TERMINATIONS

- A. Cable end terminations shall be made using two-hole, rectangular tongue, tin-plated copper compression connectors with long barrel length to permit two (2) crimps as manufactured by Burndy, Hubbell-Anderson/Fargo, Thomas & Betts, or 3M Company.
- B. All termination kits shall be suitable for the voltage rating and physical size of the cables and shall have continuous ampacity which is equal to or greater than that of the cable. Cable end terminations shall include skirted stress cones and cable stress relief.
- C. All termination kits shall have a 90 kV BIL rating and shall have a direct current 15 minute withstand rating of 50 kVDC minimum and shall be suitable for use on Type MV-105 cable with a maximum rated operating temperature of 105°C
- D. All single conductor 5 kV shielded power cable end termination kits shall be rated Class 1 (IEEE 48, latest edition) and shall be cold shrink type, 3M QT-III 76\_ \_ -S Series silicone rubber termination kit or approved equal by Elastimold or Raychem Corporation.
- E. All splice kits shall be suitable for DC HiPot testing to 35 kVDC for 15 minutes.

## 2.4 CABLE PULLING LUBRICANT

- A. Cable pulling lubricant shall be compatible with all cable jackets. The lubricant shall be UL Listed. The lubricant shall contain no greases, silicones, or polyalkylene glycol oils or waxes.
- B. A 200-gram sample of the lubricant, when placed in a one-foot, split metal conduit and fully dried for 24 hours at 105°C, shall not spread a flame more than three inches beyond a point of ignition at a continued heat flux of 40 KW/M<sup>2</sup>. Total time of test shall be one-half hour.
- C. Cable pulling lubricant shall meet the following minimum specifications:
  - 1. Lubricity at 200 lbs/ft Normal Pressure:
    - a. PVC or XLP jacketed cable/PVC conduit  
Coefficient of dynamic friction.....≤ 0.15
    - b. PVC or XLP jacketed cable/HDPE duct  
Coefficient of dynamic friction.....≤ 0.15
  - 2. Percent Non-Volatile Solids.....≤ 5.5%
  - 3. Temperature Use Range.....20°F to 110°F
  - 4. pH.....≥ 6.5, ≤ 9.0
  - 5. Flammability.....No Flash Point
  - 6. Polyethylene Stress Cracking.....None/ASTM D1693
  - 7. Temperature Stability:
    - a. < 10% change in Brookfield viscosity from 40°F to 100°F  
No separation after five freeze/thaw cycles or 24-hour exposure at 120°F
- D. Cable pulling lubricant shall be:

1. POLYWATER® J
2. 3M WL
3. Approved equal

## **2.5 CABLE MOISTURE SEALS**

- A. Cable moisture seal end caps shall provide an environmental seal for ends of non-energized medium-voltage cable.
- B. End caps shall be close-ended, tubular rubber sleeves that are factory expanded and loaded onto a removable core, 3M Cold Shrink EC Series or approved equal by Elastimold or Raychem Corporation.

## **PART 3 - EXECUTION**

### **3.1 CABLE INSTALLATION**

- A. All 5 kV cables shall be installed in an underground duct bank duct or rigid metal conduit.
- B. All cable ends shall be kept sealed prior to installation and immediately following installation, until splices or end terminations are made, using cold shrink end caps as recommended by the cap manufacturer for the cable outside diameter over the outer jacket to keep moisture out of the cable.
- C. Examine raceways, pull boxes, and other cable installation locations for cleanliness of duct/raceway, minimum bending radii of cables, and conditions affecting performance of cable.
- D. Proof duct prior to installing cables to verify suitable conditions by passing a wire brush mandrel and then a rubber duct swab through the duct. Pull the wire brush and rubber swab through the duct at the same time with the rubber swab located 48 to 72 inches behind the wire brush on the pull rope. Do not proceed with cable installation until unsatisfactory conditions have been corrected.
  1. Wire Brush Mandrel: Wire bristle brush approximately the same size as conduit inner diameter with stiff steel bristles and an eye on each end for attaching to the pull ropes. If obstruction is felt, pull the brush back and forth repeatedly to break up the obstruction.
  2. Rubber Duct Swab: Consists of a series of rubber discs approximately the size of the conduit inner diameter on a length of steel cable with an eye on each end for attaching to the pull ropes. Pull the rubber duct swab through the duct to extract the loose debris dislodged by the wire brush mandrel from the duct.
- E. Measure all raceways to accurately determine the exact lengths of cable required before installation.
- F. Verify and inspect each end of every shipping length of cable for water in strands and check dimensionally for conformance with indicated standards.
- G. Observe all National Electrical Code, National Electrical Safety Code and IEEE 576 requirements regarding installation of medium-voltage cables.

- H. Install cables and accessories in compliance with manufacturer's recommendations and written instructions. Adhere to recommendations for cable and ambient temperatures at time of installation.
- I. Cable reels should be held in warm storage area at temperature of at least 60°F (16°C) for 24 hours to ensure total warm-up. Prior to installation, cables should be handled, if temperature is lower than 20°F, in the 24-hour period proceeding pulling and bending. If no indoor warming area is available a plastic sheeting covering shelter may be constructed and heat provided by Contractor.
- J. All cables shall be installed directly from reels. Cables shall not be pulled along the ground or subjected to treatment that may cause abrasion or other damage to the cable jacket or insulation.
- K. Pull conductors simultaneously where more than one cable is indicated in same raceway. Use UL listed and manufacturer approved pulling compound or lubricant. Avoid twisting, kinking or abrasion of cables and observe manufacturer's bending radius requirements.
- L. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values during installation of cables. Utilize pulling tension measuring equipment and submit a table of the maximum pulling tension measured during each cable pull.
- M. Use pulling means, including fish tape, cable, rope and pulling eye that will not damage cables or raceways. Do not use rope hitches or basket weave wire/cable grips for pulling attachment to cable. Utilize pulling eyes that mechanically fasten to the conductor of each cable in the raceway to distribute the pulling tension equally on all cables.
- N. Use pull-in guides, cable feeders, pulleys, and draw-in protectors as required to protect cables from damage during installation.
- O. Seal all cable ends with rubber tape before pulling in to prevent moisture in duct from infiltrating the cable jacket and insulation. Do not pull cables with ends unsealed.
- P. Pull cable continuously and without starting/stopping/starting.
- Q. Care shall be taken not to damage cables during installation. The Construction Representative shall be notified of any damage and the Designer will evaluate repairs or replacement.
- R. Install sufficient length of cable to allow removal of ends damaged during installation. Remove damaged ends, or the last 3 feet of cable, whichever is longer, on each end after installation in raceway and before termination.
- S. Install medium-voltage power cable with adequate bending radius in accordance with the National Electrical Code and the cable manufacturer's recommendations:
  - 1. Greater than twelve (12) times the cable outside diameter for medium voltage, shielded cable.
- T. The grounding conductor associated with each set of medium-voltage cables shall be bonded to the cable support bushing and/or conduit grounding bushing inside all electrical equipment enclosures and shall be connected to the equipment ground bus inside the electrical equipment at each end of the cable run.

### 3.2 CABLE TERMINATION INSTALLATION

- A. Cables shall not be spliced inside electrical equipment. Cables that are too short for terminating in equipment shall be removed and replaced.
- B. All medium-voltage power cable end terminations shall be made using kits specifically designed for the particular application. The termination kit manufacturer's instructions for performing the work shall be rigidly followed.
- C. It shall be this Contractor's responsibility to furnish, deliver and install the exact sizing and type of connection necessary for each termination using the special tools that are required for the installation.
- D. Unless the Contractor's cable splicer has documented first-hand experience with installation of the exact type of termination kits required for this project, the manufacturer of the termination kit equipment shall field instruct the Contractor's personnel on creating a satisfactory connection by demonstration of at least one single cable termination of each different type used on this project, in the presence of the Designer and/or Construction Representative.
- E. Terminations shall only be performed by personnel trained and experienced in the installation of this type of materials. Submit the qualifications of cable splicer for review prior to commencement of any work in the field.
- F. All termination kits shall be suitable for the voltage rating and physical size of the cable and shall have continuous ampacity which is equal to or greater than that of the cable. Skirted stress cones shall be provided, and stress relief shall be developed at all terminations.
- G. Tighten electrical connectors and terminals in accordance with manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A.
- H. Ground shields of shielded cable at all terminations. Ground metal bodies of terminations, cable connector fittings and hardware in accordance with the manufacturer's written instructions.

### 3.3 MEDIUM-VOLTAGE POWER CABLE IDENTIFICATION

- A. Identify cables in accordance with Section 260553 – Identification for Electrical Systems.

### 3.4 CABLE TESTING

- A. Prior to cable installation, measure conductor resistance and shield resistance on each shipping length of cable and record. Test at room temperature per manufacturer requirements. Measure insulation resistance and provide insulation resistance constant not less than 20,000 at 60°C.
- B. Preparation: Perform the following preparations in advance of DC HiPot testing.
  - 1. Test cables' insulation resistance
  - 2. Test circuits' continuity
  - 3. Make power available at test locations

- C. Schedule tests and notify the Construction Representative at least one week in advance of schedule for test commencement.
- D. Submit results all preparatory testing to Designer indicating date of testing, name(s) and employer of individual(s) performing the testing, test equipment used for the testing including make, model, serial number and calibration date.
- E. Test procedure shall conform to the following:
  - 1. Test Objectives: To ensure cable installation is operational within industry and manufacturer's tolerances, is installed in accordance with Contract Documents, and is suitable for energizing.
  - 2. Procedures: Comply with IEEE 48 and IEEE 400. Upon completion of tests, attach a label to tested components.
- F. All medium-voltage cables shall be given a direct current high potential (DC HiPot) test by an independent cable acceptance testing firm, approved by the Designer, after the cable has been pulled into the raceway and all splices and terminations have been made but before the shrink tubing has been installed. Cables shall be disconnected from the end termination equipment during testing. Lightning arrestors and capacitors, if used, must be disconnected during testing.
- G. Acceptable independent cable acceptance testing firms:
  - 1. ABB Services  
Kansas City, KS  
(913) 286-8028  
Roger Andrews
  - 2. Eaton Electrical Services and Systems (EESS)  
62 Soccer Park Rd.  
Fenton, MO 63026  
(262) 309-3440  
Brad Gilmer
  - 3. Schneider Electric Services  
1101 Jefferson Street  
Pacific, MO 63069  
(314) 378-2407  
Mike Berra
- H. All medium-voltage cables shall be tested in accordance with the cable manufacturer's recommendations.
- I. Cable continuity and phase identification shall be checked.
- J. Each conductor shall be given a full dielectric absorption test with a 2,500-volt motor driven megger prior to the high potential test. The test shall be applied to fully charge the conductor. Megger readings shall be taken every 15 seconds during the first three minutes and at one-minute intervals thereafter until three equal readings one minute apart are obtained. The cable may then be considered fully charged. The minimum megger reading shall be 200 megohms.

- K. Direct current high potential tests shall be used to determine the suitability of the cable for use. The maximum DC voltage to be used for testing shall be 35,000 volts for new 5 kV cable and 10,000 volts for existing 5 kV cable.
- L. The test voltage shall be applied gradually in 5 kV increments until the final value of test voltage is reached. Additional steps may be included if required by the testing firm.
- M. Voltage shall be held at each step until the leakage current stabilizes. Maximum test voltage shall be held for 15 minutes for new cables and 10 minutes for existing cables.
- N. The values of leakage current versus voltage shall be plotted on 8-1/2 inch x 11-inch graph paper as the test progresses in order to keep a check on the condition of the cable. As long as this curve stabilizes and is relatively flat (equal increments of voltage giving equal increments of current) the cable under test may be considered to be in good condition for acceptance. At some point the current may start rising at a more rapid rate and may show up on the plot as a knee in the curve. If this point on the curve is obtained at a point considerably below the maximum test voltage, the test shall be stopped, and the Contractor shall await further instructions from the Designer or Construction Representative.
- O. When the maximum test voltage is reached, it shall be left on and the leakage current shall be plotted versus time at 15-second intervals for one minute and then at one-minute intervals until the initial high charging value reaches a steady state value, normally within 3-5 minutes. Maximum test voltage shall be held for 15 minutes. Any subsequent increase of current during this test is indicative of a bad cable or equipment and the test should be stopped and await further instructions from the Designer or Construction Representative.
- P. After the current has stabilized and the last reading is taken, the equipment should be turned off. The voltage on all three phases shall be recorded after one-minute discharge time. The voltage discharge time down to 1 kV shall be recorded. With the voltage at zero, the cable shall be connected to ground and then disconnected from the test equipment.
- Q. Each cable shall be tested between one conductor and ground with the other two conductors, metallic shielding and the metal sheath connected to ground.
- R. The test record shall include cable identification, date, voltage versus leakage current graph, leaking current versus time graph, measured temperature and humidity at test location, operator and firm who performed tests, and one-line diagram of the cable tested. One-line diagram shall include cable lengths, splices, terminations, etc., with the location and type of installation indicated.
- S. All test results shall be certified and submitted to and approved by the Designer prior to energization of any cables or on the first business day after completion of the testing if the testing is performed at a time other than normal weekday business hours.
- T. After successful completion of the total circuit DC HiPot testing, including discharging the cables as specified herein, the shrink tubing shall be applied at all terminations, the cables terminated, and the shields grounded at the terminations.

## **END OF SECTION 260513**



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

## **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 SCOPE**

- A. The Contractor shall furnish and install all conductors, wiring, and cables as specified herein and as shown on the Drawings.

### **1.3 RELATED SECTIONS**

- A. Section 260500 – Common Work Results for Electrical
- B. Section 260526 – Grounding and Bonding for Electrical Systems
- C. Section 260533.13 – Conduit for Electrical Systems
- D. Section 260533.16 – Boxes for Electrical Systems
- E. Section 260553 – Identification for Electrical Systems
- F. Section 260583 – Wiring Connections

### **1.4 SUBMITTALS**

- A. Manufacturer's product data sheets shall be submitted for each of the following items:
  - 1. 600-volt building wire
  - 2. 600-volt mineral-insulated power cable and accessories
  - 3. 600-volt multiconductor control cable
  - 4. 600-volt mineral-insulated multiconductor control cable and accessories
  - 5. 600-volt shielded instrumentation cable
  - 6. CAT 6 copper Ethernet cable
- B. Submit test report indicating results for copper wire and cable continuity and resistance testing and Type MI cable insulation resistance testing and megger testing.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- A. All cable and wire shall have copper conductors; aluminum shall not be substituted nor permitted.
- B. All conductors shall be new, shall be approved and listed by Underwriters' Laboratories, Inc., (UL), shall bear UL identification, and shall have been manufactured within six months from

date of the Contract. If requested by the Designer, the Contractor shall supply authenticated data from the wire manufacturer stating the manufacturing date of the wire.

- C. All wire sizes are expressed in American Wire Gauge (AWG) or in circular mils. Unless otherwise indicated, all conductors shall have 90°C rated insulation (wet or dry). The current rating of all conductor sizes shall be calculated using the correction factors and ambient temperature adjustment factors in NEC Article 310-15(B) but under no circumstance shall exceed the values listed in the 60°C temperature column of the tables for circuits 100 amps and below or the 75°C temperature column for circuits over 100 amps.
- D. Conductors for all branch circuits and feeders shall be color coded in accordance with the National Electrical Code (NEC) and correctly phased throughout the electrical system.

## **2.2 600-VOLT BUILDING WIRE**

- A. All conductors for lighting and power systems, including equipment grounding conductors and single conductor control wiring shall be copper, 600-volt, single conductor building wire.
- B. All 600-volt conductors installed underground conduits shall be:
  - 1. Conductor: ASTM B3, annealed copper. Conductor sizes 12 and 10 AWG shall be solid, 8 AWG and larger and 14 AWG single conductor control wiring shall be stranded per ASTM B8. Minimum conductor size shall be 12 AWG except for single conductor control wiring which shall be 14 AWG.
  - 2. Insulation: 600-volt, Flame Retardant, thermoset Cross-linked Polyethylene (XLPE) per ICEA S-95-658/NEMA WC70 Section 3; thickness per UL 44 and ICEA S-98-658/WC70, Table 3-4, Column B
  - 3. Temperature Rating, Continuous Use: 90°C wet or dry locations
  - 4. UL Listed: Type XHHW-2
  - 5. Testing: All cables shall be tested in accordance with the applicable requirements of ICEA S-95-658/NEMA WC70.
  - 6. Certification: All cables shall be certified to be in conformance with all applicable requirements of ICEA S-95-658/NEMA WC70.
  - 7. Identification: Surface printing on the cable shall show manufacturer's name, conductor size and metal, voltage rating, UL symbol, insulation type and color per NEC Article 310-110 – Conductor Identification and Section 260553 – Identification for Electrical Systems.
  - 8. Manufacturer: Alanwire, Cerrowire, General Cable Company, Service Wire Company, Southwire Company or approved equal.
- C. All 600-volt conductors located solely within the building shall be:
  - 1. Conductor: ASTM B3, annealed copper. Conductor sizes 12 and 10 AWG shall be solid, 8 AWG and larger and 14 AWG single conductor control wiring shall be stranded per ASTM B8. Minimum conductor size shall be 12 AWG except for single conductor control wiring which shall be 14 AWG.
  - 2. Insulation: 600-volt, heat and moisture resistant, Gasoline and Oil Resistant I and II, polyvinyl chloride (PVC) per UL Standard 83; thickness per UL Standard 83

3. Jacket: A tough nylon jacket shall be applied directly over the insulation per UL Standard 83.
  4. Temperature Rating, Continuous Use: 90°C wet or dry locations
  5. UL Listed: Type THHN-THWN-2
  6. Testing: All cables shall be tested in accordance with the applicable requirements of UL Standard 83.
  7. Certification: All cables shall be certified to be in conformance with all applicable requirements of UL Standard 83.
  8. Identification: Surface printing on the cable shall show manufacturer's name, conductor size and metal, voltage rating, UL symbol, insulation type and color per NEC Article 310-110 – Conductor Identification and Section 260553 – Identification for Electrical Systems.
  9. Manufacturer: Alanwire, Cerrowire, General Cable Company, Service Wire Company, Southwire Company or approved equal.
- D. Leads to special equipment shall be as recommended or supplied by the fixture or equipment manufacturer and as shown on the Drawings or as required by applicable codes.

### **2.3 600-VOLT MINERAL-INSULATED (TYPE MI) POWER CABLE**

- A. Description: Solid copper conductors encased in compressed metal oxide with an outer metallic sheath, rated 600-volt.
- B. Basis-of-Design Product: Subject to compliance with requirements, provide PYROTENAX, a brand of nVent; System 1850 MI cables (local sales representative David Reeb, Martin Electrical Sales, 314-280-4672) or comparable product by one of the following:
  1. MI Cable Company
  2. Watlow Electric Manufacturing Company
- C. Standards:
  1. Listed and labeled as defined in NFPA 70/CSA 22 part 2, by a qualified testing agency, and marked for intended location and use.
  2. UL 2196/ULC S139 for fire resistance.
  3. Conductor and Cable Marking: Comply with wire and cable marking in accordance with UL's "Wire and Cable Marking and Application Guide."
- D. Properties:
  1. Inorganic composition. Polymeric insulation not allowed. Cables that generate toxic or combustible gases when heated shall not be permitted.
  2. Insulation Voltage Rating: 600-volts
  3. Cable Temperature Rating: 482 deg F (250 deg C)
  4. Termination Temperature Rating: 392 deg F (200 deg C)
  5. Conduit not required

- E. Conductors: Copper, complying with ASTM B3 for bare annealed copper
- F. Insulation: Compressed magnesium oxide
- G. Sheath: Seamless soft-drawn copper
- H. Components:
  - 1. Mineral-insulated cable components shall be cCSAus, ETL or UL certified.
  - 2. Splices, Field and Factory:
    - a. No MI cable to MI cable splices allowed.
  - 3. Terminations, Field and Factory:
    - a. Basis of Design Product: PYROTENAX, a brand of nVent; Pyropak termination kit for 3-conductor size 3 AWG 600-volt Type MI cable.
- I. Type MI cable warranty:
  - 1. Provide a thirty (30) year warranty from date of sale.
  - 2. Warranty information shall be published on the cable manufacturer's website.
  - 3. After installation contractor submits results of insulation resistance testing and post installation megger testing to cable manufacturer, cable manufacturer shall provide a written certificate of warranty that shall be included as part of the contract close-out documents.

## **2.4 600-VOLT MULTI-CONDUCTOR CONTROL CABLE**

- A. All low voltage control cable shall be copper, 600-volt, unshielded, multi-conductor control cable conforming to ICEA S-73-532/NEMA WC57.
  - 1. Conductors: ASTM B3 and B8; Class B stranded, bare annealed copper conforming to ICEA S-73-532/NEMA WC57. Size 18 AWG, 16 AWG or 14 AWG as indicated on the Drawings. Where no size is indicated use size 16 AWG.
  - 2. Insulation: 600-volt, flame-retardant, polyvinyl chloride (PVC) with clear polyamide (nylon) per ICEA S-73-532/NEMA WC57; minimum thickness: 15 mils PVC and 4 mils nylon per ICEA S-73-532/NEMA WC57 Table 3-1. Color coding shall be ICEA Method 1, E-2. Where wire colors white and/or green are required, color coding shall be ICEA Method 1, E-1.
  - 3. Jacket: Lead-free, flame-retardant, sunlight resistant polyvinyl chloride (PVC) per ICEA S-73-532/NEMA WC57 Section 4, Paragraph 4.2 with thickness per ICEA S-73-532/NEMA WC57, Table 4-1 as follows:
    - a. 14 AWG, 2 to 12 conductors: 45 mils
    - b. 16 AWG, 2 to 12 conductors: 45 mils
    - c. 18 AWG, 2 to 12 conductors: 45 mils
  - 4. Temperature Rating: Cable shall be suitable for continuous use at 90°C dry, 75°C wet (ICEA S-73-532/NEMA WC57, Section 3, Paragraph 3.4.6)
  - 5. UL Listed: Type TC-ER Power and Control Tray Cable per UL 1277
  - 6. Testing: All cables shall be tested in accordance with the applicable requirements of ICEA S-73-532/NEMA WC57 and IEEE 383.

7. Certification: All cables shall be certified to be in conformance with all applicable requirements of ICEA S-73-532/NEMA WC57 and IEEE 383.
8. Flame Test Certification: Passes IEEE-383 ribbon burner flame test
9. Identification: Surface printing on the cable shall show the manufacturer's name, number and size of conductors, voltage rating, UL information, insulation type, jacket type, and numbered footage markers.
10. Manufacturer: General Cable Type VNTC, or approved equal by Basic Wire and Cable, Belden, Dekoron or Okonite

## **2.5 600-VOLT MINERAL-INSULATED (TYPE MI) MULTICONDUCTOR CONTROL CABLE**

- A. Description: Solid copper conductors encased in compressed metal oxide with an outer metallic sheath, rated 600-volt.
- B. Basis-of-Design Product: Subject to compliance with requirements, provide PYROTENAX, a brand of nVent; System 1850 MI cables (local sales representative David Reeb, Casey Electric Sales, Inc., 314-280-4672) or comparable product by one of the following:
  1. MI Company
  2. Watlow Electric Manufacturing Company
- C. Standards:
  1. Listed and labeled as defined in NFPA 70/CSA 22 part 2, by a qualified testing agency, and marked for intended location and use.
  2. UL 2196/ULC S139 for fire resistance.
  3. Conductor and Cable Marking: Comply with wire and cable marking in accordance with UL's "Wire and Cable Marking and Application Guide".
- D. Properties:
  1. Inorganic composition. Polymeric insulation not allowed. Cables that generate toxic or combustible gases when heated shall not be permitted.
  2. Insulation Voltage Rating: 600-volts
  3. Cable Temperature Rating: 482 deg F (250 deg C)
  4. Termination Temperature Rating: 392 deg F (200 deg C)
  5. Conduit not required
- E. Conductors: Copper, complying with ASTM B3 for bare annealed copper
- F. Insulation: Compressed magnesium oxide
- G. Sheath: Seamless soft-drawn copper
- H. Components:
  1. Mineral-insulated cable components shall be cCSAus, ETL or UL certified.
  2. Splices, Field and Factory:

- a. No MI cable to MI cable splices allowed.
- 3. Terminations, Field and Factory:
  - a. Basis of Design Product: PYROTENAX, a brand of nVent; Pyropak termination kit for 2-conductor size 14 AWG 600-volt Type MI cable
- I. Type MI cable warranty:
  - 1. Provide a thirty (30) year warranty from date of sale.
  - 2. Warranty information shall be published on the cable manufacturer's website.
  - 3. After installation contractor submits results of insulation resistance testing and post installation megger testing to cable manufacturer, cable manufacturer shall provide a written certificate of warranty that shall be included as part of the contract close-out documents.

## 2.6 600-VOLT SHIELDED INSTRUMENTATION CABLE

- A. Shielded instrumentation cable, with shielded twisted pairs; 600-volt rated conforming to ICEA S-73-532/NEMA WC57.
  - 1. Conductors: ASTM B3 AND B8; bare, annealed copper, Class B stranded conforming to ICEA S-73-532/NEMA WC57, size 18 AWG or 16 AWG as indicated on the Drawings. Where no size is indicated use size 18 AWG.
  - 2. Insulation: 600-volt, flame-retardant, polyvinyl chloride (PVC) with clear polyamide (nylon) per ICEA S-73-532/NEMA WC57; minimum thickness: 15 mils PVC and 4 mils nylon per ICEA S-73-532/NEMA WC57 Table 3-1. Color coding shall be by Method 1 per ICEA S-73-532/WC57 Appendix E using color-pigmented compounds. One (1) black and one (1) white conductor. When multiple pairs are used, group identification shall be by printed numbers on one conductor of each pair in consecutive order.
  - 3. Pair Shield: Aluminized polymer or aluminized polyester tape with a tinned stranded copper drain wire. Shields to be isolated from all other assemblies.
  - 4. Cable Shield: Aluminized polymer or aluminized polyester tape with a tinned stranded copper drain wire
  - 5. Jacket: Lead-free, flame-retardant, sunlight resistant polyvinyl chloride (PVC) per ICEA S-73-532/NEMA WC57 Section 4, Paragraph 4.2 with thickness per ICEA S-73-532/NEMA WC57, Table 4-1
  - 6. Identification: Surface printing on the cable shall show the manufacturer's name, insulation type, jacket type, number of pairs, size of conductors, voltage rating, and numbered footage markers.
  - 7. Temperature: Cable shall be suitable for continuous use at 90°C dry, 75°C wet (ICEA S-73-532/NEMA WC57, Section 3, Paragraph 3.4.6)
  - 8. Testing: All cables shall be tested in accordance with the applicable requirements of ICEA S-73-532/NEMA WC57 and IEEE 383.
  - 9. Certification: All cables shall be certified to be in conformance with all applicable requirements of ICEA S-73-532/NEMA WC57 and IEEE 383.
  - 10. Manufacturer: General Cable Company Type VNTC or approved equal by Basic Wire and Cable, Belden, Dekoron or Okonite

## **2.7 CAT 6 COPPER ETHERNET CABLE**

- A. 300-volt, CAT 6 (350MHz), 4-pair, U/UTP-Unshielded, indoor/outdoor, premise horizontal Ethernet cable conforming to NEC/UL Specification CMR, CMX-Outdoor.
- B. Conductors: Solid bare copper size 23 AWG
- C. Insulation: 300-volt, polyolefin (PO); minimum thickness: 0.00825", nominal thickness 0.008875". Color coding shall be:
  - 1. Pair 1: White/blue strip and blue
  - 2. Pair 2: White/orange strip and orange
  - 3. Pair 3: White/green strip and green
  - 4. Pair 4: White/brown strip and brown
- D. Jacket: Lead-free, flame-retardant, sunlight resistant polyvinyl chloride (PVC); minimum thickness 0.023", nominal thickness 0.03".
- E. Temperature Range: -40°C to +75°C
- F. Electrical Characteristics:
  - 1. Nominal Mutual Capacitance: 17 pF/ft
  - 2. Maximum Capacitance Unbalance: 330 pF/100m
  - 3. Nominal Velocity of Propagation: 68%
  - 4. Maximum Delay: 537.6ns/100m @ 100MHz
  - 5. Maximum Delay Skew: 35ns/100m
  - 6. Maximum Conductor DC Resistance: 7.8  $\Omega$ /100m @ 20°C
  - 7. Maximum DC Resistance Unbalanced: 3% @ 20°C
- G. UL Listed: Type CMG, CMR, CMX-Outdoor
- H. Testing: All cables shall be tested in accordance with UL 1666 Riser Flame Test and CSA Flame Test FT4.
- I. Manufacturer: Belden 2146A or approved by Basic Wire and Cable or Dekoron

## **2.8 600-VOLT CONNECTIONS AND TERMINATIONS**

- A. Provide connections and terminations for 600-volt wire and cable in accordance with Section 260583 – Wiring Connections.

## **2.9 CABLE PULLING LUBRICANT**

- A. Cable pulling lubricant shall be compatible with all cable jackets. The lubricant shall be UL Listed. The lubricant shall contain no greases, silicones, or polyalkylene glycol oils or waxes.
- B. A 200-gram sample of the lubricant, when placed in a one-foot, split metal conduit and fully dried for 24 hours at 105°C, shall not spread a flame more than three inches beyond

a point of ignition at a continued heat flux of 40 KW/M<sup>2</sup>. Total time of test shall be one-half hour.

C. Cable pulling lubricant shall meet the following minimum specifications:

1. Lubricity at 200 lbs/ft Normal Pressure:
  - a. PVC or XLP jacketed cable/PVC conduit  
Coefficient of dynamic friction.....≤ 0.15
  - b. PVC or XLP jacketed cable/HDPE duct  
Coefficient of dynamic friction.....≤ 0.15
2. Percent Non-Volatile Solids.....≤ 5.5%
3. Temperature Use Range.....20°F to 110°F
4. pH.....≥ 6.5, ≤ 9.0
5. Flammability.....No Flash Point
6. Polyethylene Stress Cracking.....None/ASTM D1693
7. Temperature Stability:
  - a. < 10% change in Brookfield viscosity from 40°F to 100°F  
No separation after five freeze/thaw cycles or 24-hour exposure at 120°F

D. Cable pulling lubricant shall be:

1. POLYWATER® J
2. 3M WL
3. Approved equal by Ideal

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- A. Store all conductors and cable indoors, protected from moisture.
- B. Provide homerun conductors of continuous length without joint or splice from overcurrent protective device to first load termination point.
- C. Provide power feeder conductors of continuous length without joint or splice for their entire length.
- D. Conductors shall be continuous from source to destination without splices or taps in conduit runs, except where indicated on the Drawings to compensate for voltage drop or where required to prevent excessive pulling tension or sidewall pressure on wire or cable. Submit all proposed splice locations to the Designer for approval prior to pulling wire and cable. Where permitted, splices shall be mechanically strong and have an insulation value equal to the wire or cable being spliced. All splices and taps shall be contained within NEC sized junction boxes meeting the requirements of Section 260533.16 – Boxes for Electrical Systems.
- E. All conductors and cables shall be in a raceway (conduit, duct, etc.) approved by the Designer, unless otherwise indicated.



- F. Install conductors and cable with adequate bending radius in accordance with the National Electrical Code and the conductor and cable manufacturer's recommendations:
  - 1. Greater than six (6) times the conductor and cable outside diameter for 600-volt and below wire and cable.
  - 2. Type MI Cable:
    - a. Cable OD over sheath  $\leq 0.75"$ : Five (5) times the cable diameter
    - b. Cable OD over sheath  $> 0.75"$ : Ten (10) times the cable diameter
- G. Swab the inside of conduit and raceways to insure they are dry and clean before conductors or cables are pulled. Care shall be exercised in pulling to avoid damage to the conductors or cables. Pull all conductors into a conduit at the same time. An approved type of wire pulling lubricant, UL Listed for the application, shall be used.
- H. All conductors and cables shall be installed directly from reels or coils. Conductors and cables shall not be pulled along the ground or subjected to treatment that may cause abrasion or other damage to conductor and cable insulation.
- I. Use pulling means; including fish tape, cable, rope, and basket weave wire/cable grips that do not damage the conductor, cable or raceway.
- J. All conductors and cables shall be installed as recommended by the manufacturer. The manufacturer's recommended maximum pulling tension and minimum bending radius shall be adhered to during installation. Utilize the necessary guides, pulleys, sleeves, and pulling aids to prevent abrasion and damage to the conductors or cables during installation. Monitor pulling tensions and associated sidewall pressures to prevent damage to conductors and cables.
- K. Provide individual dedicated full size neutral for each and every branch circuit.
- L. Neatly train and lace wiring inside boxes, panelboards, switchboards, switchgear and automatic transfer switches. Wire and cable shall be supported at 2-foot intervals as a minimum. Provide supplemental structural members and materials as required to support wire and cable without transmitting strain to connection points.
- M. Group and tie single conductors of a circuit together at a minimum of 2-foot intervals in boxes and all electrical equipment enclosures.
- N. Remove and discard conductors and cables cut too short or installed in wrong raceway. Do not install conductors or cables which have been removed from a raceway.
- O. Do not install conductors or cables in conduit which contains wiring already in place.
- P. Do not exceed NEC limits on conduit fill.
- Q. Conductors terminating in outlet or device boxes shall have at least 8 inches of free conductor left inside the box.
- R. Conductors for power shall not be smaller than size 12 AWG except wire supplied with equipment by the equipment manufacturer. Conductors for control wiring shall not be smaller than size 14 AWG unless otherwise indicated.
- S. Leads to special equipment shall be as recommended or supplied by the equipment manufacturer and as shown on the Drawings or as required by the applicable codes.

### **3.2 WIRING SEGREGATION**

- A. Isolate and segregate power wiring circuits from control and instrumentation wiring circuits in conduit runs, boxes, panels, and equipment.
- B. Isolate and segregate "normal" or "equipment branch emergency" power circuits from "life safety and critical branch emergency" power circuits and "life safety branch emergency" power circuits from "critical branch emergency" power circuits in conduit runs, boxes, panels, and equipment.
- C. Isolate and segregate lighting and convenience receptacle wiring circuits from power, control, and instrumentation wiring in conduit and boxes.
- D. Isolate control wiring circuits from instrumentation wiring circuits in conduit runs and boxes.
- E. In boxes, provide isolation and segregation by rigid conduit chase through box interior or continuous metal dividers of same material as the box.

### **3.3 MINERAL-INSULATED (TYPE MI) POWER CABLE INSTALLATION**

- A. Examination:
  - 1. Examine surfaces and substrates to receive Type MI cables for compliance with requirements for installation tolerances and other conditions affecting performance.
    - a. Prior to installation of Type MI cable system, verify that all mounting structures are suitably fire rated.
    - b. Ensure surfaces in contact with Type MI cables are free of burrs and sharp protrusions.
    - c. Ensure mounting structures are suitably spaced per the Type MI cable manufacturer's installation manual.
    - d. Ensure system for pulling of Type MI cable into final locations is suitable per guidelines in the Type MI cable manufacturer's installation manual.
- B. Preinstallation Testing:
  - 1. Prior to pulling Type MI cable into place, an insulation resistance test shall be performed by installing contractor to ensure integrity of Type MI cable as described in the Type MI cable manufacturer's installation manual.
  - 2. Proceed with installation only after any unsatisfactory conditions have been corrected.
- C. Preparation:
  - 1. Protect all Type MI cable ends from moisture ingress with end seals until cable is terminated.
  - 2. Provide enough excess length in cables to allow cutting back to good, dry cable at each end.
- D. Installation:

1. Support Type MI power cable to walls or columns or, in open areas, install cable on seismically supported U-channel support rack at 9'-0" minimum above finished floor.
2. Comply with the Type MI cable manufacturer's written installation manual/instructions.
3. In the field, all Type MI cables shall be meggered with 500 VDC for 600-volt Type MI cables. The following field megger readings shall be taken on each cable.
  - a. Type MI cable shall be meggered when received at Project site before installation.
  - b. Type MI cable shall be meggered after sealing termination of the MI cable, prior to being attached to the equipment at on each end of the cable.
  - c. Insulation resistance must exceed 200 megohms at 500 VDC.
  - d. All results must meet manufacturer's specification. Cables that do not pass post installation field testing must be replaced.

### **3.4 MINERAL-INSULATED (TYPE MI) MULTICONDUCTOR CONTROL CABLE INSTALLATION**

#### **A. Examination:**

1. Examine surfaces and substrates to receive Type MI cables for compliance with requirements for installation tolerances and other conditions affecting performance.
  - a. Prior to installation of Type MI cable system, verify that all mounting structures are suitably fire rated.
  - b. Ensure surfaces in contact with Type MI cables are free of burrs and sharp protrusions.
  - c. Ensure mounting structures are suitably spaced per the Type MI cable manufacturer's installation manual.
  - d. Ensure system for pulling of Type MI cable into final locations is suitable per guidelines in the Type MI cable manufacturer's installation manual.

#### **B. Preinstallation Testing:**

1. Prior to pulling Type MI cable into place, an insulation resistance test shall be performed by installing contractor to ensure integrity of Type MI cable as described in the Type MI cable manufacturer's installation manual.
2. Proceed with installation only after any unsatisfactory conditions have been corrected.

#### **C. Preparation:**

1. Protect all Type MI cable ends from moisture ingress with end seals until cable is terminated.
2. Provide enough excess length in cables to allow cutting back to good, dry cable at each end.

#### **D. Installation:**

1. Support Type MI multiconductor control cable to walls or columns or, in open areas, install cable on seismically supported U-channel support rack at 9'-0" minimum above finished floor.
2. Comply with the Type MI cable manufacturer's written installation manual/instructions.
3. In the field, all Type MI cables shall be meggered with 500 VDC for 600-volt Type MI cables. The following field megger readings shall be taken on each cable.
  - a. Type MI cable shall be meggered when received at Project site before installation.
  - b. Type MI cable shall be meggered after sealing termination of the MI cable, prior to being attached to the equipment at on each end of the cable.
  - c. Insulation resistance must exceed 200 megohms at 500 VDC.
  - d. All results must meet manufacturer's specification. Cables that do not pass post installation field testing must be replaced

### **3.5 ETHERNET CABLE INSTALLATION**

- A. Conceal cables in finished spaces in buildings inside walls and above accessible ceilings.
- B. Comply with ANSI/TIA-568.C.1.
- C. Terminate all conductors. No cable shall contain unterminated elements. Make terminations only at cable connection points at equipment. Pairs shall not be untwisted more than 0.5 inches when terminating.
- D. Cable placement shall conform to industry standards with regard to anchoring, cable support and separation from other facilities.
  1. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames and terminals.
  2. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
  3. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii. Use lacing bars and distribution spools.
  4. Cables shall not sag or droop but shall be installed so as to maintain a flat plane with smooth transitions from one level or direction to another.
- E. Where cable is installed above suspended ceilings without cable tray or conduit, support cables by J-hook, cable hook, or cable hanger system spaced a maximum of 5 feet apart. Plastic cable ties or bridle rings shall not be used.
  1. Cables shall not be attached to lift out ceiling grid supports or laid directly on the ceiling grid.
  2. Cables shall not be attached to or supported from fire sprinkler heads or delivery systems or any environmental sensor located in the ceiling air space.
- F. Install cable without damaging conductors or cable jacket.
  1. Do not install bruised, kinked, scored, deformed, or abraded cable.

2. Remove and discard cable if damaged during installation and replace with new cable.
- G. Cables shall not be spliced. Do not splice cable between termination, tap, or junction points.
  - H. Bring cable to a minimum of 60°F before de-reeling. Heat lamps shall not be used for warming cable.
  - I. Provide additional slack at both ends of cables to accommodate future cabling system changes.
    1. Do not store slack in bundled loops. Slack shall be stored in fixture-8 configuration in an extended loop. Store slack above lay-in ceiling where possible.
    2. In communications equipment room, install 10-foot long service loop on each end of cable.
    3. Leave 24-inches slack on each cable at each equipment panel.
  - J. Do not bend cable in handling or installation to smaller radii than minimums recommended by manufacturer.
  - K. Install exposed cable parallel and perpendicular to surfaces or exposed structural members and follow surface contours where possible.
  - L. Contractor shall be responsible for verifying the actual footages and distances identified on the Drawings.
  - M. Install components as indicated and according to the manufacturer's written instructions. Use techniques, practices and methods that are consistent with the requirements of the Category rating of the components.
  - N. Provide minimum separation of cables from EMI sources in accordance with the cable manufacturer's recommendations.
  - O. Test and verify cable installation after terminating at both ends in accordance with industry standards and the manufacturer's recommendations for the Category rating of the components.
  - A. CAT 6 Ethernet Cable Installation: Install using techniques, practices, and methods that are consistent with Category 6 rating of components and that ensure Category 6 performance of completed and linked signal paths, end to end.
    1. Comply with ANSI/TIA-568-C.2.
    2. Do not untwist cables more than 0.5 inches from the point of termination to maintain cable geometry.
    3. Test and verify cable installation after terminating at both ends in accordance with industry standards and the manufacturer's recommendations for the Category rating of the components.

### 3.6 WIRING CONNECTIONS AND TERMINATIONS

- A. Provide connections and terminations for 600-volt wire and cable in accordance with Section 260583 – Wiring Connections.

Change in Scope, Re-Bid: Replace Emergency Generator, Infrastructure  
St. Louis Forensic Treatment Center - South, St. Louis, Missouri

M1908-01

### **3.7 MINERAL-INSULATED (TYPE MI) POWER AND MULTICONDUCTOR CONTROL CABLE FIRESTOPPING**

- A. Apply firestopping at Type MI cable penetrations through walls to restore original fire-resistance rating of wall assembly.
- B. Fire-stopping materials shall be in accordance with Section 260533.13 - Conduit for Electrical Systems, Article 2.5 – Conduit Penetration Sealing Assemblies and Article 2.8 – Fire-Stopping Materials.

### **3.8 FIELD QUALITY CONTROL**

- A. General:
  - 1. Testing shall be performed in the presence of Construction Representative. Contractor must provide 48 hours' notice prior to conducting tests.
  - 2. Prepare a test report upon completion of testing activities. Report format shall include the following information:
    - a. Summary of test results
    - b. Test equipment summary (model number, accuracy, calibration date)
    - c. Test personnel names and sign-offs
    - d. Completed data sheets
    - e. Test log and observations
    - f. Certificate of Compliance
- B. Inspect wire and cable for physical damage and proper connection.
- C. Verify that all power conductors are properly phased throughout the electrical system.
- D. Torque test conductor connections and terminations to manufacturer's recommended values.
- E. Perform continuity tests.
- F. Perform and record results of megger tests for each phase and neutral conductor for each feeder. Include actual recorded megaohm value for each conductor of each feeder in the feeder conductor insulation test report.
- G. Provide testing for connections and terminations for 600-volt wire and cable in accordance with Section 260583 – Wiring Connections in conjunction with the testing specified herein.

**END OF SECTION 260519**

## **SECTION 260526 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**

### **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 SCOPE**

- A. The Contractor shall furnish, install and test the grounding systems as specified herein and as shown on the Drawings.

#### **1.3 RELATED SECTIONS**

- A. Section 260500 – Common Work Results for Electrical
- B. Section 260519 – Low-Voltage Electrical Power Conductors and Cables
- C. Section 260533.13 – Conduit for Electrical Systems
- D. Section 260533.16 – Boxes for Electrical Systems
- E. Section 260583 – Wiring Connections

#### **1.4 SUBMITTALS**

- A. Manufacturer's product data sheets shall be submitted for the following items:
  - 1. Grounding conductors
  - 2. Exothermic welds
  - 3. Grounding clamps
  - 4. Grounding connectors
  - 5. Grounding lugs
  - 6. Grounding rods
- B. Grounding rod resistance test report.

### **PART 2 - PRODUCTS**

#### **2.1 GROUNDING CONDUCTORS**

- A. All grounding conductors shall be insulated, stranded copper, and unless otherwise indicated, shall meet the same specifications, in accordance with Section 260519 – Low-Voltage Electrical Power Conductors and Cables, as the accompanying circuit conductors.
- B. Aluminum shall not be substituted for copper in grounding conductors.

## **2.2 EXOTHERMIC WELDS**

- A. Grounding wire connections to building steel or grounding rods shall be welded using an exothermic process, unless otherwise indicated. Approved exothermic processes shall be:
  - 1. Cadweld  
Manufactured by Erico Products, Inc.; Cleveland, Ohio
  - 2. Harger; Grayslake, Illinois
  - 3. Thermoweld  
Manufactured by Continental Industries, Inc.; Tulsa, Oklahoma
- B. Where welded electrical connections are referred to elsewhere in the Drawings or Specifications as being "cadwelded," it shall be understood that the process shall be exothermically welded by means of one of the above three manufactured methods.

## **2.3 GROUNDING CONNECTORS**

- A. Grounding conductor connections to equipment frames, equipment enclosures, and equipment ground lugs shall be made using corrosion resistant compression, bolted, or split-bolt connections. Bolts for equipment ground lugs shall be copper alloy terminal with a twin clamping element. Bolts for equipment enclosures shall be silicon bronze with lock washers. Split-bolt connectors shall be copper. Use products by Blackburn, Burndy Corp., O-Z/Gedney, Penn-Union or approved equal.
- B. Split-bolts shall be UL Listed for connection of two (2) conductors within a listed range for each connector catalog number and the tap and run conductors shall not be required to be the same size.

## **2.4 GROUNDING RODS**

- A. Grounding rods shall be 3/4-inch diameter, 10 feet long (unless indicated otherwise on the Drawings), high strength solid steel rod with a bonded copper jacket, and UL listed.
- B. Grounding rods shall be manufactured by Copperweld Steel Company, ITT Weaver; Thomas & Betts; Blackburn; Joslyn Mfg. and Supply Co.; or approved equal.

# **PART 3 - EXECUTION**

## **3.1 GENERAL**

- A. The entire electrical system and all electrical equipment shall be grounded in strict accordance with Article 250 of the National Electrical Code and as shown on the Drawings.
- B. The grounding system shall be continuous throughout the electrical system.
- C. Insulated grounding conductors shall be identified with green colored insulation or marking tape in accordance with Section 260553 – Identification for Electrical Systems and NEC Article 250-119.
- D. Grounding conductors shall be continuous with no splices.
- E. Protect grounding conductors against unraveling, caging, and abrasion by several wrappings of plastic tape on all ends, where cable leaves concrete, and at necessary intermediate points.



- F. Suitably protect grounding conductors against damage during construction. Replace or suitably repair at the discretion of the Designer or Construction Representative if cable is damaged by anyone before final acceptance.
- G. Install individual grounding conductors so as not to be entirely encircled or closely encircled by magnetic material unless it is properly bonded as specified herein.
- H. When a conduit, which is fabricated of magnetic materials (e.g., steel conduit), contains only grounding conductors, the grounding conductors shall be bonded to the conduit at both ends of the conduit run, using grounding bushings with a bonding jumper installed between each grounding conductor and the bushing.
- I. All neutral conductors shall be continuous throughout the electrical system.
- J. Power system neutrals shall be grounded only at the service entrance equipment and at the transformer or generator where each system neutral is derived in accordance with NEC Article 250.
- K. All metallic conduits shall be properly grounded.
- L. All flexible conduits shall contain a properly connected green insulated copper grounding conductor, sized in accordance with National Electrical Code, Article 250, unless otherwise indicated.
- M. Flexible conduits 1-1/2" size and larger shall have an insulated stranded copper grounding conductor sized per the NEC installed external to the conduit and bonded to grounding type conduit connectors on each end of the conduit. The grounding conductor shall be secured to the conduit using nylon cable ties at 12" intervals. Cut off excess cable tie. Do not leave sharp edges.
- N. A properly sized green insulated copper equipment grounding conductor shall be installed in each and every conduit.
- O. The grounding pole of all receptacles shall be electrically bonded to the conduit system.
- P. All flexible cords shall contain an insulated grounding conductor, color coded green, which shall be properly connected at each termination.
- Q. All electrical enclosures, control panels, boxes, conduits, equipment frames and other non-current-carrying metallic objects shall be grounded and bonded as required by the NEC.
- R. Connections: All grounding conductor connections shall be made in accordance with the manufacturer's written instructions. Chemically degrease and dry completely before exothermically welding. Make up bolted connections clean and tight. All connections shall be low resistance with a resistance drop of less than 1 ohm. Do not cover connections until they have been inspected by the Designer or Construction Representative.
- S. Grounding conductors and bonding jumper connection devices or fittings that depend on solder shall not be used.
- T. Split-bolt type connectors are only UL Listed for the connection of two (2) conductors. Main and tap conductor sizes shall be in accordance with the UL listing as indicated by the manufacturer. Connections of more than two (2) grounding conductors require the use of a

different type of UL Listed connector in accordance with Specification Section 260583 – Wiring Connections.

- U. Bond all metal conduits to the ground bus bar conductor of the control panel, terminal box, panelboard, switchboard, switchgear, disconnect safety switch, automatic transfer switch or frame of the equipment to which they are connected by terminating each conduit with a threaded steel insulated grounding bushing or insulated throat, grounding type conduit hub having a solderless lug with a bonding jumper sized in accordance with NEC Table 250-66 attached to the ground bus conductor or equipment frame. Where the enclosure does not contain a ground bus bar, bond to the enclosure using a mechanical lug. Scrape away paint at grounding lug attachment location.
- V. All control panel, panelboard, switchboard, switchgear and automatic transfer switch ground bus conductors, power transformer cases, all transformer neutrals, and all rotating electrical equipment shall be solidly and directly grounded to the nearest approved grounding point, or as shown on the Drawings, using a conductor sized in accordance with the NEC Table 250-66 or as indicated on the Drawings.
- W. Equipment grounds shall be made where indicated on the Drawings. Total resistance to ground shall not exceed five (5) ohms.

### **3.2 MOTOR GROUNDING**

- A. All motors rated 10 horsepower and below shall be grounded by an equipment grounding conductor, sized per the NEC, installed in the conduit with the power conductors that supply the motor.

### **3.3 METALLIC RACEWAY SYSTEM GROUNDING**

- A. Ground/bond metallic conduits at all termination points by means of a grounding type conduit bushing or conduit hub with grounding screw/lug on the locknut and a NEC sized insulated stranded copper bonding jumper.
- B. Where extending metallic conduit into floor or grade mounted equipment from below, provide an insulated grounding bushing on the end of the conduit and bond to the equipment ground bus or frame using a NEC sized bonding jumper.

### **3.4 GROUNDING RODS**

- A. Driven grounding rods shall be installed in areas wherever required and where shown on the Drawings.
- B. Unless otherwise indicated, grounding rods located outdoors shall be installed vertically with the top of the grounding rod 3 feet below finish grade.
- C. Grounding conductor connections to grounding rods shall be exothermically welded.

### **3.5 GROUNDING ROD TESTING**

- A. The resistance to ground at all ground rod locations shall be tested by an independent testing firm, approved by the Designer, using an AVO Biddle DET 2/2 Ground Tester, Catalog No. 250202 or approved equal using the "Fall of Potential Method." The total resistance to

ground shall not exceed five (5) ohms. If it does, the Contractor shall install additional ground rods and re-test until the resistance is below five (5) ohms.

B. Acceptable independent testing firms:

1. ABB Services  
Kansas City, KS  
(913) 286-8028  
Roger Andrews
2. Eaton Electrical Services and Systems (EESS)  
62 Soccer Park Rd.  
Fenton, MO 63026  
(262) 309-3440  
Brad Gilmer
3. Schneider Electric Services  
1101 Jefferson Street  
Pacific, MO 63069  
(314) 378-2407  
Michael Berra

C. Provide written report of test results including date and time of testing, test equipment used, test equipment calibration date, and names of individuals performing the testing,

**END OF SECTION 260526**

# **SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL EQUIPMENT**

## **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 SCOPE**

- A. The Contractor shall furnish and install all supports and fastening devices for mounting and anchoring all raceways and electrical equipment as specified herein and as shown on the Drawings.

### **1.3 RELATED SECTIONS**

- A. Section 260500 – Common Work Results for Electrical
- B. Section 260533.13 – Conduit for Electrical Systems
- C. Section 260533.16 – Boxes for Electrical Systems
- D. Section 262413 – Switchboards
- E. Section 262416 – Panelboards
- F. Section 263213.13 – Diesel-Engine-Driven Generator Set
- G. Section 263290 – Generator Connection Cabinet
- H. Section 263623 – Automatic Transfer Switches
- I. Section 263623.13 – Automatic Transfer Switch for Fire Pump

### **1.4 SUBMITTALS**

- A. Manufacturer's product data sheets shall be submitted for the following items:
  - 1. Expansion anchors
  - 2. U-channel steel supports including associated hardware and accessories
  - 3. Seismic restraints

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- A. Weld Rod: Use E70 electrodes for shielded metal arc welding.
- B. Provide materials, sizes, and types of supports, anchors, and fasteners to carry the loads of conduit, boxes, and equipment. Include weight of wire and cable when selecting products for conduit, equipment and box supports.

## 2.2 ANCHORS AND FASTENERS

- A. Provide anchors and fasteners as required to install all conduit, boxes, electrical enclosures, and equipment.
- B. Expansion Anchors: Utilize expansion anchors for attachment of electrical equipment, boxes and raceways to concrete and solid masonry surfaces.
  - 1. Expansion anchors shall be stud type expansion anchor with a single-piece, three-section wedge, Hilti Kwik Bolt TZ2 or approved equal installed per the manufacturer's written recommendations. The anchors shall meet the description in Federal Specification FF-S-325, Group II, Type 4, Class 1, for concrete expansion anchors and shall comply with ASTM 153. All bolts shall have length identification.
  - 2. Indoors: Galvanized steel
  - 3. Outdoors: Type 304 stainless steel
- C. Provide adequate corrosion resistance for all fastening systems.
- D. Bolts and Nuts: ANSI regular series, semi-finished, hexagon
  - 1. Indoors: Cadmium plated steel
  - 2. Outdoors: Type 304 stainless steel
- E. Flat Washers:
  - 1. Indoors: Cadmium plated steel
  - 2. Outdoors: Type 304 stainless steel
- F. Lock Washers: ANSI medium, spring type
  - 1. Indoors: Cadmium plated steel
  - 2. Outdoors: Type 304 stainless steel
- G. Beam Clamps: Steel beam and angle clamps by B-Line or Thompson
  - 1. Indoors: Cadmium, zinc plated or hot-dipped galvanized
  - 2. Outdoors: Type 304 stainless steel
- H. U-Bolts: 1/4" minimum size
  - 1. Indoors: Cadmium or zinc plated steel or hot-dipped galvanized steel
  - 2. Outdoors: Type 304 stainless steel furnished with Type 304 hardware

## 2.3 STRUCTURAL SUPPORT SYSTEMS

- A. Steel Supports: Brackets, frames and hangers shall be fabricated from standard cold rolled structural steel shapes or prefabricated structural systems, as manufactured by B-Line Systems, Inc., Unistrut Corporation, Kindorf Electrical Products Co., or approved equal.
  - 1. Steel supports and accessories used indoors shall be made from steel meeting the minimum mechanical properties of ASTM A1011 SS Grade 33, then electro-plated with zinc per ASTM B633. Fittings shall be manufactured from steel meeting the minimum requirements of ASTM A907 SS, Grade 33. All fittings and hardware shall

be zinc plated in accordance with ASTM B633 (SC3 for fittings, SC1 for threaded hardware).

2. Steel supports and accessories used outdoors or in indoor wet areas shall be hot-dipped galvanized steel after fabrication per ASTM A123 with a minimum coating thickness of 2.5 mils or Type 304 stainless steel.
3. Steel supports shall be 14-gauge or 12-gauge and either 1-5/8" x 13/16" or 1-5/8" x 1-5/8" as required based on equipment to be supported or as indicated on the Drawings.

B. Hanger Supports: Threaded rods

1. Indoors: Electro-galvanized steel
2. Outdoors: Type 304 stainless steel

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- A. The methods of attaching or fastening equipment or equipment supports or hangers to the building structure shall be subject to the approval of the Construction Representative.
- B. Do not drill or cut any structural steel members.
- C. Do not cut any structural concrete members.
- D. Welding on any structure shall require prior written approval from the Construction Representative for each type of application except where specifically shown on the Drawings. Weld in accordance with AWS requirements.
- E. Do not use piping, ductwork, raceways, or equipment as structural members for support.
- F. Equipment or raceways shall not be attached to or supported from the roof deck, from removable or knockout panels, or temporary walls or partitions unless specifically indicated on the Drawings.
- G. A minimum of four (4) anchor points shall be provided for electrical equipment enclosures and dimensioned boxes.
- H. Outdoor supports shall be installed to provide a minimum of 13/16" air space between wall mounted electrical equipment enclosures and mounting surface.
- I. Provide corrosion resistant spacers, minimum 1/4"-thick, behind all equipment enclosures mounted on surfaces that are located in damp or wet locations such that the back of the enclosure is not in direct contact with the mounting surface.

### **3.2 ANCHORS AND FASTENERS**

- A. Unless noted otherwise on the Drawings, expansion anchor minimum embedment shall be as follows:

| <u>Bolt Diameter, in.</u> | <u>Embedment, in.</u> |
|---------------------------|-----------------------|
| 1/4                       | 2                     |
| 3/8                       | 2-1/2                 |

|     |       |
|-----|-------|
| 1/2 | 3-1/2 |
| 5/8 | 4     |
| 3/4 | 4-3/4 |

- B. Anchor bolts for the new switchboard and automatic transfer switches are to be the maximum diameter that will fit through the factory provided holes in the equipment base with a minimum of 6" embedment in the concrete floor below the housekeeping pad. Provide Belleville washers or square U-channel support washers per the equipment manufacturer's installation instructions for seismic restraint.
- C. Utilize welded fasteners or beam clamps for attachment of electrical equipment and raceways to structural steel surfaces in accordance with the requirements of the Designer or Construction Representative. Weld in accordance with AWS requirements.
- D. Utilize toggle bolts, hollow wall fasteners or through-wall bolt fasteners for attachment of electrical equipment, boxes and raceways to hollow masonry surfaces.
- E. Utilize machine screws for attachment of electrical equipment, boxes and raceways to metal surfaces.
- F. Nails shall not be used as a means of fastening.
- G. Do not use spring steel clips.
- H. Do not use powder-actuated anchors.

### **3.3 STRUCTURAL SUPPORT SYSTEMS**

- A. Weld in accordance with AWS.
- B. Any galvanizing damaged by welding or erection shall be repaired with cold galvanizing per ASTM A780. Surface preparation shall include power disk sanding the abraded or welded area to bright metal.
- C. Do not use chain.
- D. Do not use perforated strap or wire.

### **3.4 SEISMIC BRACING**

- A. All electrical equipment shall be bolted down, and conduit shall be braced in accordance with the seismic design requirements of the International Building Code (latest adopted edition), utilizing the seismic loading factors noted on the Structural Drawings.
- B. All floor mounted control panels and electrical equipment enclosures shall be properly and rigidly fastened to the floor in accordance with the equipment manufacturer's requirements.
- C. Conduit trapeze hangers shall be stabilized both horizontally and vertically to prevent swaying or movement.
- D. Transverse and longitudinal braces shall be no more than 45° above or below the centerline of the conduit.

- E. When bracing trapeze type hangers, the bracing shall be attached directly to the trapeze hanger assembly, and the conduit shall be secured to the trapeze assembly with conduit straps.
- F. Seismic bracing shall not limit the expansion and contraction of the conduit system.
- G. Contractor shall field locate bracing as required unless otherwise shown on the Drawings.
- H. Seismic restraints may be omitted from the following installations:
  - 1. All conduit suspended by individual hangers 12 inches or less in length from the top of the conduit to the bottom of the support for the hanger.
  - 2. All electrical conduit less than 2-1/2 inches inside diameter.
- I. Detailed design and installation of all electrical conduit supports and seismic restraints shall be the Contractor's responsibility.
- J. Provide seismic-restraints complying with the requirements of the City of St. Louis Building Codes, applicable ASME Codes, NEC, and industry standards (e.g., MSS SP-58, Pipe Hangers and Supports and MSS SP-127, Bracing For Piping Systems: Seismic - Wind - Dynamic Design, Selection, And Application).
- K. Seismic restraints are to be included in the submittal requirements for electrical supports and hangers.

**END OF SECTION 260529**



## **SECTION 260533.13 – CONDUIT FOR ELECTRICAL SYSTEMS**

### **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 SCOPE**

- A. The Contractor shall furnish and install all raceways and fittings as specified herein and as shown on the Drawings.

#### **1.3 RELATED SECTIONS**

- A. Division 03 – Concrete
- B. Section 090100 – Painting & Coating
- C. Section 260500 – Common Work Results for Electrical
- D. Section 260513 – Medium-Voltage Cables
- E. Section 260519 – Low-Voltage Electrical Power Conductors and Cables
- F. Section 260526 – Grounding and Bonding for Electrical Systems
- G. Section 260529 – Hangers and Supports for Electrical Equipment
- H. Section 260533.16 – Boxes for Electrical Systems
- I. Section 260553 – Identification for Electrical Systems
- J. Division 31 – Earthwork

#### **1.4 SUBMITTALS**

- A. Manufacturer's product data sheets shall be submitted for the following items:
  - 1. Each type of conduit (galvanized rigid steel, rigid aluminum, electrical metallic tubing, liquidtight flexible metallic, rigid non-metallic)
  - 2. Conduit hubs
  - 3. Conduit expansion fittings
  - 4. Internal conduit sealing bushings
  - 5. External conduit sealing bushings or link seals
  - 6. Conduit penetration sealing assemblies
  - 7. Conduit bodies
  - 8. Conduit mounting clamps
  - 9. Fire-stopping materials

10. Intumescent silicone sealant
11. Protective coating for direct buried metal conduit
12. Underground conduit warning tape
13. Conduit/duct plugs
14. Conduit spacers for underground conduit duct banks
15. Red cement coloring dye for concrete encased conduit duct banks

## **PART 2 - PRODUCTS**

### **2.1 CONDUIT**

- A. All conduit shall be new and shall be approved and listed by Underwriters' Laboratories, Inc. (UL) and shall bear the UL label of approval.
- B. All conduit shall be one of the following:
  1. Galvanized rigid steel conduit, "Heavywall" (GRC), shall be Schedule 40 steel conduit, hot dipped galvanized on both the outside and the inside. Conduit as obtained from the manufacturer shall have been cut and threaded before galvanizing, thereby insuring the galvanizing of these areas. Conduit shall conform to the latest editions ANSI Standard C80.1 and UL Standard No. 6 and shall meet the requirements of NEC Article 344.
    - a. Minimum conduit size shall be 3/4-inch.
    - b. Running threads are not permitted.
    - c. GRC shall be used outdoors above grade down to 18" below grade.
  2. Rigid aluminum conduit (RAC), heavywall, copper-free threaded aluminum in accordance with ANSI C80.5 and shall meet the requirements of NEC Article 344.
    - a. Minimum conduit size shall be 1-1/2-inch.
    - b. Running threads are not permitted.
    - c. Rigid aluminum conduit may be substituted for GRC in sizes 1-1/2" and larger except as follows:
      - 1) Rigid aluminum conduit shall not be installed on the roof of a building.
      - 2) Rigid aluminum conduit shall not be installed in poured concrete.
      - 3) Rigid aluminum conduit shall not be installed in locations or environments known to be corrosive to aluminum.
  3. Electrical metallic tubing (EMT) shall be thin wall steel conduit, hot dipped galvanized on both the outside and the inside. EMT shall conform to ANSI Standard C80.3 and U.L. Standard 797 and shall meet the requirements of NEC Article 358.
    - a. Minimum conduit size shall be 3/4-inch.
    - b. All connectors and couplings shall be zinc plated steel. Die cast zinc type are not acceptable.
      - 1) Size 2-1/2" and smaller compression type

- 2) Size 3" and larger set-screw type
  - c. Connectors up to and including size 1-1/2" shall be insulated throat type. All connectors shall be terminated with a bonding type locknut. Threaded steel insulated grounding bushings having solderless lugs shall be used on connector sizes 1-1/4" and larger.
  - d. EMT shall be used indoors in dry locations.
4. Liquidtight flexible metal conduit (LFMC) shall be square locked galvanized steel flexible tubing having an extruded liquidtight thermoplastic or polyvinyl chloride (PVC) jacket, making the conduit moisture proof, oil proof, and sunlight resistant LFMC shall conform to U.L. Standard 360 and shall meet the requirements of NEC Article 350. Liquidtight flexible metal conduit shall be used at all locations where a flexible conduit connection is required.
- a. Minimum conduit size shall be 1/2-inch.
  - b. Conduit and fittings shall be rated for 90°C conductors or cable and for use in direct sunlight.
  - c. Liquidtight flexible metal conduit shall contain a continuous copper ground built into the core in sizes 1/2-inch through 1-1/4-inch, and all sizes shall be approved and listed by Underwriters' Laboratories, Inc. (UL). Liquidtight flexible metal conduit shall be rated for a minimum temperature range of -20°C (-4°F) to +60°C (+140°F), and shall be as manufactured by the following:
    - 1) Anamet, Inc., Type UA
    - 2) Electri-Flex Company, Type LA Liqueatite
    - 3) Southwire/Alflex, Type UL Ultratite
  - d. All connectors and couplings for liquidtight flexible metal conduit shall be malleable iron with hot-dipped galvanized or steel with zinc plated finish, compression ring, positive ground, positive grip, liquid tight, rain-tight and oil tight.
  - e. All connectors and fittings shall be UL Listed as suitable for grounding in sizes 1/2-inch through 1-1/4-inch.
  - f. All connectors shall be insulated throat type. All connectors shall be terminated with a bonding type locknut. Threaded steel insulated grounding bushings having solderless lugs shall be used on connector sizes 1-1/4" and larger.
  - g. All connectors in sizes 1-1/2-inch and larger shall have a grounding lug on the gland nut for connection of an external grounding conductor in accordance with Section 260526 - Grounding and Bonding for Electrical Systems.
  - h. Neither flexible metal conduit ("greenfield") nor liquidtight flexible nonmetallic conduit shall be substituted for liquidtight flexible metal conduit.
  - i. Unless otherwise indicated, liquidtight flexible metal conduit shall only be used for the final connection to:
    - 1) Vibrating type equipment, such as motors, generators, HVAC equipment, and transformers (flexible connection not to exceed 3 feet).

- 2) All remotely located control devices and instrumentation such as limit switches, pressure switches, transmitters, etc. (flexible connection not to exceed 3 feet).
  - 3) As permitted elsewhere in these Specifications or Drawings.
5. Rigid non-metallic conduit shall be heavy wall Schedule 40 (NEMA EPC-40 PVC, Type II-III) polyvinyl chloride (PVC) electrical plastic conduit and shall meet the requirements of NEC Article 352. Rigid non-metallic conduit shall be as manufactured by Carlon Electrical Products; Condux International, Inc.; Can-Tex Industries; CertainTeed Products Corp.; or approved equal.
- a. Minimum conduit size shall be 1-inch.
  - b. Rigid non-metallic conduit (PVC) shall only be used below grade.
  - c. Adhesive for PVC conduit shall be as recommended by the manufacturer of the PVC conduit

## 2.2 CONDUIT HUBS

- A. Conduit hubs shall be insulated throat, liquid-tight "copper-free" aluminum for aluminum conduit and zinc plated steel or malleable iron for rigid galvanized steel conduit, grounding type with ground lug/screw on the lock nut.
- B. Conduit hubs shall be Myers Type STAG or STG Scru-Tite or approved equal.

## 2.3 CONDUIT EXPANSION FITTINGS

- A. Conduit expansion fittings shall be of sufficient length to provide for proper expansion and contraction of the conduit run without inflicting any damage to either the conduit or the conductors inside the conduit.
- B. Expansion fittings for galvanized rigid steel conduit shall be weatherproof, fabricated from hot dipped galvanized malleable iron or electrogalvanized steel with phenolic or Teflon insulating bushings, providing for 8 inches of conduit movement (4 inches in either direction), and shall be O-Z/Gedney Type AXB-8; Cooper Crouse-Hinds Type XJG; or approved equal by Appleton Electric.
- C. Expansion fittings for rigid aluminum conduit shall be weatherproof, fabricated from "copper-free" aluminum with phenolic or Teflon insulating bushings, providing for 8 inches of conduit movement (4 inches in either direction), and shall be Cooper Crouse-Hinds Type XJG-SA or approved equal by O-Z/Gedney or Appleton Electric.
- D. Expansion fittings shall be UL Listed and internally grounded with a tinned copper bonding jumper or electrogalvanized phosphor bronze ground springs to maintain electrical continuity through the fitting.

## 2.4 CONDUIT SEALING BUSHINGS

- A. Internal Conduit Sealing Bushings: Designed to seal around the conductors/cables inside a conduit and shall have a one-piece, neoprene ring between two (2) PVC coated steel discs that are custom drilled to accommodate the conductors contained in the conduit and are held together by stainless steel socket or hex head screws with stainless steel washers. Conductor holes in the PVC coated steel rings shall be slotted to eliminate inductive heating.

- B. Internal conduit sealing bushings shall be designed for installation inside the end of a rigid metal conduit and shall be O-Z/Gedney Type CSBI (standard or segmented style), or approved equal.
- C. External Conduit Sealing Bushings: Designed to seal around the outside of a conduit at concrete or masonry wall penetrations and shall be O-Z/Gedney Type CSM, or an interlocking EDPM rubber link assembly, with stainless steel bolts and nuts, Link-Seal Model S-316 by Pipeline Seal and Insulator, Inc., or approved equal.

## 2.5 CONDUIT PENETRATION SEALING ASSEMBLIES

- A. Environmental Conduit Penetration Sealing Assemblies: Use to seal around conduit penetrations between interior temperature controlled and non-temperature controlled spaces and between above grade indoor and outdoor areas.
- B. Sealing assembly shall be modular, mechanical type, consisting of inter-locking synthetic EPDM (black) rubber seal elements shaped to continuously fill the annular space between the conduit and the wall or floor opening. The elastomeric element shall be sized and selected per manufacturer's recommendations with a temperature range of -40°F to +250°F.
- C. Pressure plates and bolting shall be steel with 2-part zinc dichromate and organic coating or glass reinforced nylon.
- D. Fire Rated Conduit Penetration Sealing Assemblies: Use to seal around conduit penetrations in fire rated construction.
- E. Sealing assembly shall be modular, mechanical type, consisting of interlocking silicone (grey) rubber seal elements shaped to continuously fill the annular space between the conduit and the wall or floor opening. The elastomeric element shall be sized and selected per manufacturer's recommendations with a temperature range of -67°F to +400°F.
- F. Pressure plates and bolting shall be steel with 2-part zinc dichromate.
- G. Single Link Seal shall provide a Factory Mutual Approved 1 hour fire stop rating.
- H. Provide double fire rated conduit seal consisting of two single fire conduit seals back-to-back with a tie rod that tightens both seals simultaneously to provide a Factory Mutual Approved 3-hour fire stop rating.
- I. Conduit penetration sealing assembly shall be Link-Seal Model C by PSI Seal and Insulator, Inc., or Link Seal Catalog No. LSA by Cooper Crouse-Hinds or approved equal.

## 2.6 CONDUIT BODIES

- A. Conduit bodies shall be provided as required or where indicated on the Drawings and shall be hot-dipped galvanized malleable iron with galvanized steel gasketed covers or cast, "copper-free" aluminum having threaded hubs and stainless steel or "copper-free" aluminum, neoprene gasketed covers fastened with stainless steel screws, rain-tight, suitable for wet locations, Crouse-Hinds, Appleton or O-Z Gedney Form 35, Form 8, Mark 9, or Mogul. Die-cast aluminum types are not acceptable.

- B. Conduit body cover screws shall thread directly into the conduit body. Conduit body covers with wedge-clamp type covers are not acceptable.
- C. Conduit body hub configuration shall be as required based on conduit routing for the cover to be readily accessible for easy removal.
- D. Conduit bodies enclosing size 6 AWG or smaller conductors shall have a cross-sectional area not less than twice the cross-sectional area of the largest conduit to which the conduit body is attached.
- E. The maximum number of conductors shall be computed in accordance with NEC Article 314-16(C).

## **2.7 CONDUIT MOUNTING CLAMPS**

- A. Conduit mounting clamps for securing conduits inside buildings shall be galvanized steel one-hole, two-hole or H-Type (mini's). Conduit mounting clamps used outdoors shall be Type 304 stainless steel. Conduits mounted on a roof are to be galvanized steel and shall be painted as indicated on the Drawings.
- B. Conduit mounting clamps for securing rigid metal conduits to concrete or masonry surfaces inside buildings shall be one piece "copper-free" aluminum or zinc plated malleable iron one hole type, Crouse-Hinds Cat. No. 5XX or approved equal with Crouse-Hinds Cat. No. CBX or approved equal "copper-free" aluminum or zinc plated malleable iron clamp backs/spacers.
- C. Conduit mounting clamps for mounting conduits to U-channel supports shall be electro-plated zinc, hot-dipped galvanized steel after fabrication per ASTM A123 with minimum coating thickness of 2.5 mils, or Type 304 stainless steel to match channel support material, B-Line B2000 Series or approved equal.

## **2.8 FIRE-STOPPING MATERIALS**

- A. The following fire-resistant penetration sealing materials are approved for use in indoor dry areas:
  - 1. 3M Caulk CP 25
  - 2. 3M Wrap/Strip FS-195
  - 3. Damming materials – 3M Composite Sheet CS-195
  - 4. SpecSeal Series 100 sealant
  - 5. Rector Seal Corporation, Metacaulk 835 fire stopping sealant
  - 6. Dow Corning 3-6548 silicone RTV foam
  - 7. General Electric GE RTV850 or GE RTV6428
  - 8. Chase Technology Corporation CTC PR-855 fire-resistant silicone foam

## **2.9 INTUMESCENT SILICONE SEALANT**

- A. Intumescent silicone sealant shall meet UL Water Leakage Test – Class 1 requirements and shall be re-enterable and repairable; 3M Fire Barrier Water Tight Silicone Sealant 3000WT or Designer approved equal.

- B. Utilize 6 psf mineral wool as packing material behind the 3M UL listed 3000WT intumescent silicone sealant.

## **2.10 CONDUIT PULL STRING**

- A. Conduit pull string shall be Greenlee or equal with a minimum of 240 lbs. tensile strength, and shall be rot and mildew resistant. Pull string shall have permanently printed sequential measurements at one-foot increments.

## **2.11 PROTECTIVE COATING FOR DIRECT BURIED METAL CONDUIT**

- A. Protective coating for direct buried metallic conduit shall be Kop-Coat, Inc. Bitumastic No. 50 or two coats of 3M Scotchrap pipe primer over wrapped in accordance with the manufacturer's written instructions with 3M No. 51, 20 mil thick tape.

## **2.12 UNDERGROUND CONDUIT WARNING TAPE**

- A. Warning tape shall be fabricated from polyethylene film, and shall be 6 inches wide and not less than 3.5 mils thick.
- B. Warning tape for all directly buried electrical conduit shall be high visibility red in color and imprinted at frequent intervals with black letters having the following wording:

CAUTION BURIED ELECTRIC LINE BELOW

- C. Warning tapes shall be Terra-Tape "Extra Stretch" manufactured by Reef Industries, Inc., or approved equal, by EMED Co., Inc., Seton, W. H. Brady Co., or Allen Systems, Inc.

## **2.13 CONDUIT/DUCT PLUGS**

- A. Plugs for sealing empty duct bank conduits shall be compressible natural rubber with stainless steel plate on both sides with stainless steel bolt and stainless-steel wing nut or hex nut for compressing the rubber plug between the two stainless steel plates to secure it inside the conduit or duct or all plastic/rubber with no metal parts.
- B. Conduit/duct plugs shall be T-Cone Plug by ETCO Specialty Products or Blank Duct Plug by Calam or approved equal by Osbourne Associates, Inc.

## **2.14 DUCT BANK CONDUIT SPACERS**

- A. Conduit spacers shall be as manufactured by Formex Manufacturing, Inc., Carlon Electrical Products, Condux International, Inc., Certainteed Product Corp. or Can-Tex Industries.

## **2.15 CONCRETE ENCASED DUCT BANK COLOR ADDITIVE**

- A. The concrete for all concrete encased duct banks shall have the color additive Solomon Grind-Chem Service, Inc. #366 "Utility Red" with a minimum concentration of 2 lbs per sack of cement, Davis Colors "Underground Utility Red" with a minimum concentration of 3 lbs. per sack of cement, Scofield "Underground Utility Red" with a minimum concentration of 2 lbs. per sack of cement or approved equal.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

#### **A. CONDUIT**

1. Verify routing and termination locations of conduit runs prior to rough-in.
2. Conduit routing shown on Drawings is approximate. Route as required to complete wiring.
3. Design, layout, and detail conduit runs to permit installation.
4. Coordinate conduit routing with the Construction Representative to avoid equipment operational and maintenance interferences and to permit easy removal of all conduit body and box covers.
5. Conduit or fittings having any type of defects shall not be used in the work.
6. Exposed conduit shall be run perpendicular or parallel to building walls. Where more than one conduit in a bank of exposed conduit changes direction, all bends shall be concentric.
7. The Contractor shall consult all the other trade drawings to ascertain where conflicts may occur and shall install all conduit as required to avoid conflicts.
8. Conduits shall be continuous from outlet to outlet, from outlet to junction or pull boxes, from source panel to equipment, and shall be terminated to all boxes and enclosures in such a manner that the conduit system is mechanically and electrically continuous throughout the system.
9. The Contractor shall furnish and install NEC sized pull boxes or conduit bodies wherever necessary in order that a run of conduit between conductor/cable pulling points does not contain more than the equivalent of four quarter (90 degree) bends (360 degrees total).
10. Conduit bends shall not be less than the standard radius, unless otherwise indicated.
11. A minimum clearance of nine inches (9") shall be maintained between all conduits and pipes carrying steam, hot liquids, or hot gases, except at points of cross over, in which case the clearance may be reduced to six inches (6"). Any exceptions to this shall be presented to the Designer for approval on an individual case by case basis.
12. Maintain adequate clearance between conduit and piping, allowing for the maintenance of insulation and outer protective covering on piping.
13. Couplings for conduits in a group shall be staggered at least six (6) inches.
14. Conduit shall not be routed along floors.
15. Conduits shall be concealed in finished spaces and exposed in unfinished spaces.
16. In unfinished spaces, arrange conduit to maintain minimum 7'-6" headroom above floors, unless otherwise approved by the Construction Representative.
17. All rigid metal conduit, threaded joints and couplings shall be made up wrench tight with at least five full threads engaged. The use of running threads at conduit couplings and terminations is prohibited. All cut ends of conduits shall be reamed to remove rough edges and shall be free of burrs and sharp edges. An approved aluminum lubricant shall be used with rigid aluminum conduit.



18. Coat all field cut threads on rigid galvanized steel conduit with a conductive anti-corrosion surface compound such as Thomas & Betts KOPR-Shield.
19. Coat all scars or wrench abrasions in rigid galvanized steel conduit with an approved organic zinc rich primer equivalent to Koppers' "Organic Zinc."
20. Plastic or steel caps or bushing pennies shall be placed in the end of each conduit as soon as it is located to prevent filling with foreign materials, until the conductors are installed.
21. Unless otherwise indicated, the exposed ends of all spare conduits shall be threaded and closed with a screw cap.
22. Conduit shall be supported on approved types of steel brackets, channels, ceiling trapeze, pipe straps or hangers secured by means of toggle bolts, hollow wall fasteners or through wall bolt fasteners on hollow masonry or clay tile blocks; or expansion anchors in concrete or brick; or machine screws on metal surfaces; or wood screws on wood construction. Nails or powder-actuated anchors shall not be used as a means of fastening. Perforated flat steel straps or wire shall not be used for supporting conduit. All conduit shall be properly supported in accordance with Section 260529 – Hangers and Supports for Electrical Equipment in order to deter any possible vibration, noise or chatter.
23. Conduit shall be supported from building structures. Do not use piping, ductwork, other raceways or equipment for supporting conduits. Support all conduit runs at a minimum of every 10 feet and within 3 feet of all terminations.
24. Independently support conduits from building structure above acoustical panel lay-in ceilings. Do not fasten conduits to ceiling support wires.
25. Where possible, group conduits on U-channel conduit racks.
26. Utilize U-channel supports and associated fittings and hardware for conduit support in accordance with Section 260529 – Hangers and Supports for Electrical Equipment.
27. Terminate rigid metal conduits at all NEMA Type 1 junction and pull boxes and equipment enclosures inside buildings with a minimum of two (2) locknuts, one inside and one outside the enclosure, and a steel or malleable iron insulated throat, grounding bushing having a solderless lug and a copper bonding jumper, sized in accordance with NEC Article 250, to connect the conduit to the equipment grounding bus bar located inside the enclosure. Provide a grounding lug where the enclosure does not contain an equipment grounding bus bar.
28. Provide insulated throat, liquid tight, grounding type conduit hubs to terminate rigid metal conduits at all NEMA Type 3, 3R, 4, 4X, 12 and 13 enclosures without integral cast threaded hubs. Provide a copper bonding jumper, sized in accordance with NEC Article 250, to connect the conduit hub locknut to the equipment grounding bus bar located inside the enclosure. Provide a grounding lug where the enclosure does not contain an equipment grounding bus bar.
29. Conduits or raceways, including the end fittings, entering the bottom of a floor or grade mounted enclosure without legs, such as a panelboard, switchboard or switchgear, shall terminate 2 inches above the bottom of the enclosure or top of concrete equipment pad on which the enclosure stands. Provide an insulated grounding bushing on the end of each conduit and bond to the enclosure ground bus.

30. Grounding and bonding of conduit shall be in accordance with Section 260526 – Grounding and Bonding for Electrical Systems.
31. Paint outdoor conduits located on the roof of the building in accordance with Section 090100 – Painting & Coating as indicated on the Drawings. Do not paint the pull-out distance of a conduit at on the moving side of a conduit expansion fitting as indicated by the fitting manufacturer to allow the conduit to move freely into the fitting.
32. Identify all conduit runs; both new conduit and existing that is reused, in accordance with Section 260553 – Identification for Electrical Systems.
33. Prior to installing any cables in any existing conduit that is to be reused, demonstrate to the Construction Representative that the conduit is clear of obstructions by pulling a mandrel 1/2-inch smaller than the nominal size of the conduit through the entire length of the conduit.
34. Provide a nylon or polypropylene pull string in all empty or "spare" underground conduits. Provide three feet of string inside the panelboard or junction box at each end of the conduit and tie off inside the enclosure.

**B. CONDUIT EXPANSION FITTINGS**

1. All above grade conduits shall be provided with conduit expansion fittings (1) in extremely long straight runs (100 linear feet or more), (2) where a raceway crosses a building expansion, control or vibration insulation joint, (3) where an outdoor raceway extends below grade from above grade, (4) where an outdoor conduit connects between two above grade structures, such as a building and an equipment screen wall, or (5) wherever else it is required or indicated on the Drawings or in these Specifications to compensate for the thermal expansion and contraction of the conduit.
2. Expansion fittings shall be installed in the center of the movement in an ambient temperature of 90°F. Expansion fittings installed in other ambient temperatures shall have the pull-out distance of the movement adjusted accordingly.
3. Expansion fittings of adjacent conduits located within a distance of three conduit diameters, shall be staggered at least 6 inches.
4. Provide adequate service loop in all conductors in pull box, junction box or equipment enclosure nearest the expansion fitting to allow for movement of the conduit without damage to conductors or strain on equipment or device terminations. If there is no box or electrical enclosure within 25 feet of expansion fitting provide a junction box, sized in accordance with NEC Article 314-16 or 314-28, located within 6 feet of the static end of the expansion fitting for this purpose.
5. Clamp the conduit on the static end of the expansion fitting tightly within 12-inches of the expansion fitting. Utilize H-Type conduit clamps one size larger than the conduit to be supported at all other conduit support locations up to the next expansion fitting, junction/pull box, equipment or building wall penetration to allow conduit to expand and contract within the conduit support system.

**C. CONDUIT SEALING BUSHINGS**

1. Provide internal conduit sealing bushings at all electrical enclosures where a conduit is exposed to widely different temperatures, or where an underground

conduit enters a building horizontally below grade to prevent condensation or moisture inside the conduit from entering the enclosure.

2. For conduit/conductor arrangements for which a factory drilled conduit sealing bushing is not available, seal the inside of the conduit, around the conductors or cables, at the first conduit body or enclosure inside each building using an intumescent silicone sealant.
3. Provide external conduit sealing bushings at all conduits entering a building through a concrete or masonry wall. Sealing devices shall be installed such that all bolts in the sealing bushing or link seal are accessible.
4. Completely seal around cables at all underground conduits terminating in outdoor transformers or generator circuit breaker, panelboard, or other electrical enclosure using an intumescent silicone sealant.

#### D. CONDUIT BODIES

1. Conduit bodies shall be sized for the conductor fill of the conduits to which it is connected. Use Mogul type conduit bodies if/as required.
2. Conduit body sizing shall be based on the maximum number of conductors permitted accordance with NEC Article 314-16(C).
3. Conduit bodies enclosing size 6 AWG or smaller conductors shall have a cross-sectional area not less than twice the cross-sectional area of the largest conduit to which the conduit body is attached.
4. Conduit bodies are not permitted to contain splices, taps, or devices.
5. Conduit bodies shall be supported in a rigid and secure manner.

#### E. CONDUIT MOUNTING CLAMPS

1. Conduit shall not be mounted in direct contact with any concrete or masonry wall or ceiling. Utilize U-channel supports or clamp backs/spacers to hold conduits a minimum of 3/16 inch away from concrete or masonry surfaces. Clamp backs/spacers shall be stackable to allow the conduit to be spaced further away from the mounting surface as required.

#### F. CONDUIT OPENINGS

1. Provide conduit openings in floors, walls, ceilings and roofs as required to install conduit runs. Openings shall be kept to a minimum, as small as possible, and installed in a neat manner. All damage to existing surrounding surfaces when installing openings shall be repaired to original condition.
2. Locations of all openings shall be approved by the Construction Representative before beginning work.
3. Core drill all openings in existing concrete or masonry surfaces using a dustless method.
4. After installation of conduit, openings in interior concrete or masonry walls shall be formed, grouted, and caulked to provide a moisture and fire barrier that is equivalent to the fire rating of the wall or floor.
5. All openings through which a conduit passes in interior walls and floors shall be properly sealed after the conduit is installed to prevent transmission or leakage of liquids, dust, fire, smoke, or sound. Openings in non-fire rated concrete or

masonry construction through which conduit passes shall be sealed, after the conduit is installed, with material similar to that which surrounds the opening. Openings in fire-rated construction through which conduit passes shall be sealed, after the conduit is installed, with an APPROVED fire-resistant penetration seal. All fire-resistant penetration seals shall be installed in accordance with the manufacturer's instructions.

6. Provide conduit penetration sealing assembly for all openings in floors, walls, and ceilings between interior temperature controlled and non-temperature controlled areas and between indoor areas and above grade outdoor areas.
7. Exterior metal wall panel openings shall be cut or punched. After installation of conduit, the opening shall be flashed and caulked to provide a weather-tight seal. Fire barrier caulk shall be used if the exterior wall is designated as a fire wall.

#### G. UNDERGROUND CONDUIT

1. Unless otherwise indicated, all underground conduit located outside building areas shall have a minimum slope of 1/2% toward the drainage point, or as shown on the Drawings, and shall be a minimum of three feet (3'-0") below finish grade to the top of the conduit.
2. Trenching, excavation, and backfilling for all underground conduit shall be accomplished as specified herein or shown on the Drawings.
3. Trench widths shall be kept to a minimum and bottoms shall be graded to a uniform slope. The bottom of the trench shall be kept free of water. If required to protect the excavation or personnel, shoring and sheeting of a design and materials suitable to maintain the trench in a safe and workable condition shall be provided. Adequate barricades shall be installed around excavations to protect workers and the public during the construction. Provide temporary supports for all underground utilities crossing an excavation.
4. Each underground conduit shall have a minimum of 3 inches and a maximum of 6 inches of concrete around it in all directions.
5. Group conduits into a duct bank using intermediate and base spacers to obtain uniform separation and alignment during the installation of the concrete. Maximum intervals between spacers shall be 8 feet.
6. All metallic conduit directly buried in earth shall be completely coated with two 15- to 18-mil thick coats of an approved bitumastic coal tar protective coating or two coats of 3M Scotchrap pipe primer overwrapped in accordance with the manufacturer's written instructions with 3M No. 51 tape before the conduit trench is backfilled. Rigid metal conduit shall extend 18-inches below grade before converting to Schedule 40 PVC conduit.
7. Backfill for trenches containing a conduit duct bank shall be in accordance with Division 31 – Earthwork. Any settlement shall be corrected by refilling and retamping. No puddling will be permitted.
8. Underground conduit duct banks shall be at least 12 inches away from gas, water or other pipe lines.
9. Conduits shall have long swept elbows.
  - a. Size 2" and below – 24" minimum radius
  - b. Size 2-1/2" and above – 36" minimum radius

10. Factory elbows for conduit sizes 2 inches and larger shall be rigid galvanized steel Schedule 40.
11. All PVC conduit couplings, connectors and fittings shall be properly glued to the conduit, pushing the conduit all the way in to the stop on the coupling, and using the adhesive recommended by the manufacturer of the PVC conduit to form a watertight seal at each joint.

#### H. UNDERGROUND CONDUIT WARNING TAPE

1. Unless otherwise indicated, the location of all directly buried conduits and underground conduit duct banks shall be marked by burying one or more warning tapes below grade in the backfill. The warning tape(s) shall be placed 18 inches above the top of the conduit(s) or duct bank and shall be parallel along the full length of the run. Where the top of the conduit(s) or duct bank is less than three feet (3'-0") below finish grade the warning tape shall be placed 12 inches above the top of the conduit(s) or duct bank.
2. If the width of the conduits or duct bank is wider than 2 feet, two or more warning tapes shall be used, all in the same plane, spacing the tapes no more than 12 inches apart horizontally across the top width of the conduits or duct bank and equally spacing the tapes in from each longitudinal outer edge of the buried conduits or duct bank.
3. Contractor shall exercise care to ensure that the warning tape is properly located.

#### I. CONDUIT/DUCT PLUGS

1. Install conduit/duct plug in all spare (empty) conduits/ducts as indicated on the Drawings to prevent vermin from entering electrical equipment through the conduit.
2. Size plugs based on the trade size of the conduit/duct to be sealed.
3. Tie-off pull tape/string to eye on duct plug before inserting into conduit/duct to be sealed.
4. Install plugs in accordance with the manufacturer's directions. Plugs shall be inserted in the conduit or duct such that they fit flush with the end of the raceway. Tighten down the nut to create a water-tight seal but do not over-tighten.

### 3.2 ELECTRICAL CONDUIT DUCT BANK EARTHWORK

- A. Earthwork shall comply with Division 31 – Earthwork.
- B. Conduit duct bank base spacers shall be adequately and properly supported on solid earth, or other indicated means, throughout the entire length of the run. All conduit shall be laid straight and true.

### 3.3 ELECTRICAL CONDUIT DUCT BANK CONCRETE AND FORMWORK

- A. All concrete and formwork shall be in accordance with Division 3 – Concrete.
- B. The red color additive for concrete encased duct banks shall be mixed throughout all of the duct bank concrete. "Sprinkling" of the color additive on the top of the concrete and "working" in after the concrete has been poured is not acceptable.

- C. Concrete shall be placed with the aid of a mechanical vibrator.
- D. Underground electrical conduit duct bank excavations shall not be backfilled until concrete has cured to a minimum of 50% of rated strength, seven (7) days minimum, unless otherwise approved by the Engineer.

### **3.4 UNDERGROUND UTILITIES**

- A. The Drawings indicate the location of underground structures and/or utilities located in the areas to be excavated based on the drawings from the original construction of the building and existing generator. These drawings are available for the Contractor's use.
- B. The Contractor shall communicate with Missouri One Call, telephone 1-800-DIG-RITE (1-800-344-7483), 72 hours in advance of any underground work for locating publicly owned underground utilities.
- C. The majority of the underground utilities at the facility are privately owned. The Contractor shall use extreme care and caution during excavation and backfilling to avoid damage to any existing underground structures and utility lines. Prior to and during excavation, the Contractor shall use every means to determine the exact location of all underground structures, electrical conduit, pipe lines, telephone cables, water lines, gas lines, sewer lines, conduit duct banks, etc., in the immediate vicinity of the excavation by utilizing the services of an independent utility locate company.
- D. The Contractor shall be solely responsible for the protection, repairs, or replacement of any existing underground item which was broken or otherwise damaged by the Contractor, including any consequential damage resulting therefrom, either above or below ground.
- E. All conduit, water, gas, and sewer pipes adjacent to or crossing excavations shall be properly supported and protected by the Contractor.

**END OF SECTION 260533.13**

## **SECTION 260533.16 – BOXES FOR ELECTRICAL SYSTEMS**

### **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 SCOPE**

- A. The Contractor shall furnish and install all electrical boxes as specified herein and as shown on the Drawings.

#### **1.3 RELATED SECTIONS**

- A. Section 260500 – Common Work Results for Electrical
- B. Section 260519 – Low-Voltage Electrical Power Conductors and Cables
- C. Section 260526 – Grounding and Bonding for Electrical Systems
- D. Section 260529 – Hangers and Supports for Electrical Equipment
- E. Section 260533.13 – Conduit for Electrical Systems
- F. Section 260553 – Identification for Electrical Systems
- G. Section 262726 – Wiring Devices

#### **1.4 SUBMITTALS**

- A. Manufacturer's product data sheets shall be submitted for the following items:
  - 1. Outlet and non-dimensioned junction and pull boxes
  - 2. Device boxes
  - 3. Dimensioned junction and pull boxes

### **PART 2 - PRODUCTS**

#### **2.1 GENERAL**

- A. All electrical boxes, including extension rings, covers and other accessories, shall be UL Listed and Labeled.
- B. All outlet, device and non-dimensioned junction and pull boxes shall be sized in accordance with the allowable wiring fill permitted by the National Electrical Code (NEC).
- C. Junction boxes and pull boxes shall be sized as per the NEC or as shown on the Drawings.
- D. Outlet boxes shall be of the size and type to accommodate the structural conditions, the size and number of raceways, conductors or cables entering, and the wiring device with which the

box is intended to be used. Install blank plates on all outlet boxes where apparatus is installed which does not, in itself, provide a cover for the box.

- E. Unless otherwise indicated, all junction or pull box covers shall be fastened with cadmium plated or galvanized steel screws or bolts for indoor applications and stainless-steel screws or bolts for outdoor applications. The removable cover shall be fabricated from the same material as the box, and the cover shall be on the largest accessible side of the box unless otherwise indicated. The cover of the box shall be designed for quick removal.
- F. Boxes shall be as manufactured by Appleton Electric Company, Eaton Crouse-Hinds, Steel City, Racor, Killark Electric Manufacturing Company, O-Z/Gedney Company, Hoffman Engineering Company, Wiegmann or approved equal.

## **2.2 BOXES FOR NONHAZARDOUS AREAS**

- A. Non-dimensioned junction and pull boxes and device boxes located indoors shall be hot-dipped galvanized drawn steel, 4-inch square, 4-11/16-inch square or octagon, 1-1/2 inch minimum depth, NEMA Type 1. Boxes with spot welded corners are not acceptable. Sectional type boxes are not acceptable.
- B. Non-dimensioned junction boxes and device boxes located outdoors shall be cast, cadmium or zinc plated malleable iron or "copper-free" aluminum, having threaded hubs and neoprene gasketed covers fastened with four (4) stainless steel screws, NEMA Type 4, Crouse-Hinds Type GRFX, or GS, or approved equal, or Crouse-Hinds, Appleton Electric or Killark 2-1/8 inch deep Type FD, or approved equal.
- C. Dimensioned junction and pull boxes located indoors shall be painted steel, galvanized steel or code gauge sheet aluminum, NEMA Type 1 having removable covers fastened with cadmium plated or galvanized steel screws, and continuously welded seams (ground smooth) with no holes or knockouts.
- D. Dimensioned junction and pull boxes located outdoors, above grade shall be Type 304 stainless steel, NEMA Type 4X having hinged, neoprene gasketed covers fastened with 304 stainless steel screws, and continuously welded seams (ground smooth) with no holes or knockouts.
- E. Pull and junction boxes shall be sized in accordance with NEC Article 314-16 or 314-28 as a minimum. Larger boxes may be provided.
- F. Provide hinged cover enclosures for any box larger than 12 inches in any dimension.
- G. Provide grounded metallic barriers in dimensioned junction and pull boxes as required to isolate life safety and critical branch emergency power circuits from normal or equipment branch emergency power circuits and all power circuits from other types of circuits. Barriers shall be designed so as not to separate the phases of a power circuit. Barriers shall be constructed of the same material as the box in which they are installed.
- H. Inner Back Panels: Provide white painted steel, galvanized steel, or code gauge sheet aluminum inner back panel, to match box construction, inside all boxes in which terminal blocks or control devices are located.



## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

#### **A. Boxes, General**

1. Locate and install boxes to allow access. Coordinate with other trades to ensure boxes are not made inaccessible by equipment, duct work or piping installation.
2. Locate and install to maintain headroom and to present a neat appearance.
3. Special care shall be taken to set all boxes square and true with the building finish. As far as possible, all boxes shall be secured to the building structure or steel, using adjustable supports where necessary.
4. Outlet boxes in unfinished areas shall be surface (exposed) mounted to columns or walls, unless otherwise indicated.
5. Final correct readjustment shall be made to outlet boxes, if necessary, to give proper centering. In centering and location of outlet boxes, allowance shall be made for overhead pipes, ducts, and other mechanical equipment and for variation in the arrangement and thickness of walls, fireproofing, etc. Any inaccuracy resulting from failure to take the above into consideration shall be corrected by the Contractor without additional expense to the Owner.
6. Boxes located in damp or wet locations shall have stainless steel or other Designer approved corrosion resistant spacers installed to provide a minimum of 1/4-inch air space between the back of the box and the mounting surface.
7. All boxes shall be rigidly mounted.
8. Securely fasten boxes to building structure, independent of the conduit, except for splice boxes that are connected to two metal conduits, both supported within 12 inches of the box.
9. All conduits entering sheet metal junction or pull boxes shall be through holes properly cut with a punch and die. Cast boxes shall be provided with threaded conduit bosses or hubs of proper size and externally located cast feet for mounting.
10. All open conduit knockouts, holes or hubs in electrical enclosures that are not used shall be properly plugged with suitable blanking devices of the same material as the box that maintain the NEMA rating of the box. Utilize stainless steel blanking devices for stainless steel boxes. Utilize NEMA 12 rated hole seals devices to seal all open holes in the top of all panelboards, switchboards, switchgear, motor control centers, automatic transfer switches, and in NEMA 12 rated dimensioned junction boxes and pull boxes. Provide NEMA 4X rated hole seals for NEMA 4X rated junction and pull boxes and electrical enclosures.
11. Junction and pull boxes shall be furnished and installed where indicated on the Drawings, required by code, and wherever else such a box may be deemed necessary to facilitate the pulling or splicing of wires or cables. In general, junction or pull boxes shall be installed to limit conduit runs to 125 feet and conduit bends to a maximum total of 360 degrees. The Contractor shall furnish and install properly sized pull boxes wherever necessary in order that a run of conduit between outlet and outlet, between fitting and fitting, or between outlet and fitting shall not contain more than the equivalent of four quarter (90 degree) bends (360 degrees total). Additional pull boxes may be needed to facilitate wire pulling. All boxes shall be installed in locations that will be accessible after completion of the construction.

12. Dimensioned pull and junction boxes shall be sized in accordance with NEC Article 314-28 unless a larger size box is indicated on the Drawings.
13. If strain relief members need to be installed inside junction and pull boxes or electrical equipment enclosures, for example to prevent large conductors entering the back of a box from pressing against the inside of the removable cover, utilize fiberglass U-channel support members. Do not install any wood, or other combustible type materials, inside any electrical enclosure.
14. Location of junction and pull boxes shall be approved before installation. Where necessary, conduits may be rerouted with the approval of the Construction Representative.
15. Rigid metal conduits terminating in all NEMA Type 3, 3R, 4, 4X, 12 or 13 boxes and enclosures, without integral cast threaded hubs shall be terminated in insulated throat, grounding type, liquid tight, rigid conduit hubs. Conduit hubs shall be provided in accordance with Section 260533.13 – Conduit for Electrical Systems.
16. Provide a grounding type conduit bushing with solderless lug and copper bonding jumper sized in accordance with NEC Article 250 for all conduits terminating in NEMA Type 1 boxes and enclosures in accordance with Section 260526 – Grounding and Bonding for Electrical Systems.
17. All junction boxes, pull boxes, and wire troughs with a hinged cover shall be installed such that the cover can be opened at least 90 degrees.
18. Junction and pull boxes with a hinged cover that are located on a wall shall be mounted such that the cover opens to the right or to the left but not up or down.

### **3.2 CIRCUIT IDENTIFICATION**

- A. Junction, pull, outlet, and device boxes shall be identified in accordance with the requirements of Section 260553 – Identification for Electrical Systems.
- B. Cover plates for all junction and pull boxes shall be marked on the inside surface of the cover plate in finished areas or on the outside surface of the cover in unfinished areas in accordance with Section 260553 – Identification for Electrical Systems.
- C. All conductors in a junction or pull box shall be identified in accordance with Section 260553 – Identification for Electrical Systems.

### **END OF SECTION 260533.16**

## **SECTION 260553 – IDENTIFICATION FOR ELECTRICAL SYSTEMS**

### **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 SCOPE**

- A. The Contractor shall furnish and install electrical identification for electrical equipment, conductors, cables, and boxes as specified herein and as shown on the Drawings.

#### **1.3 RELATED SECTIONS**

- A. Section 260500 – Common Work Results for Electrical
- B. Section 260513 – Medium-Voltage Cables
- C. Section 260519 – Low-Voltage Electrical Power Conductors & Cables
- D. Section 260533.13 – Conduit for Electrical Systems
- E. Section 260533.16 – Boxes for Electrical Systems
- F. Section 260573 – Protective Device Coordination Study and Arc Flash Risk Assessment
- G. Section 262413 – Switchboards
- H. Section 262416 – Panelboards
- I. Section 262726 – Wiring Devices
- J. Section 262816.13 – Enclosed Circuit Breakers
- K. Section 263213.13 – Diesel-Engine-Driven Generator Set
- L. Section 263290 – Generator Connection Cabinet
- M. Section 263623 – Automatic Transfer Switches, Open Transition
- N. Section 263623.13 – Automatic Transfer Switches, Closed Transition (Alternate Bid No. 1)
- O. Section 263623.16 – Automatic Transfer Switch for Fire Pump

#### **1.4 SUBMITTALS**

- A. Submit electrical identification data as follows:
  - 1. Nameplate type product data
  - 2. Nameplate engraving schedule

3. Wire and cable identification label product data
4. Medium-voltage power circuit identification tags
5. Conduit marker product data
6. Arc flash hazard warning labels

## **PART 2 - PRODUCTS**

### **2.1 NAMEPLATES**

- A. Nameplates shall be three-layer laminated plastic with engraved black characters on a white background for normal power system equipment and equipment branch emergency power system equipment and engraved white characters on a red background for life safety branch and critical branch emergency power system equipment as indicated on the Drawings.
- B. Nameplates that will be located outdoors must be constructed from material that is waterproof and UV resistant.
- C. Nameplate engraving shall be as follows:
  1. Lettering font shall be Gothic.
  2. Nameplate character sizes shall be:
    - a. 1-inch high – Fire pump circuit breaker in main switchboard “MSB” and in emergency switchboard “MESB1”.
    - b. 3/4-inch high – Switchboards, enclosed circuit breakers and automatic transfer switches
    - c. 1/2-inch high - Switchboard feeder circuit breakers
    - d. 3/8-inch high – Panelboards, control panels, enclosed switches, motor controllers, terminal boxes, dimensioned junction boxes and dimensioned pull boxes.
    - e. 3/16-inch high – Local control stations
  3. Lettering shall be centered on nameplate.
  4. Nameplates shall have a maximum of forty (40) characters per line with a maximum of four (4) lines.
  5. Wording on each nameplate shall contain the following information as appropriate.
    - a. Equipment designation as indicated on the Drawings, such as: PANEL 2HCS
    - b. Voltage and phases such as: 480V-3PH-3W
    - c. Designation of source equipment, such as: FED FROM PANEL 1HCS
    - d. Location of source equipment, such as: ROOM C122
  6. Engraving designations shall be approved by the Designer.
- D. Special nameplates shall be as specified herein or as indicated on the Drawings.

## **2.2 CONDUIT MARKERS**

- A. Conduit markers shall be vinyl "peel and stick" type with black characters on an orange background:
  - 1. Conduits 1-1/4" and smaller characters..... 1/2"
  - 2. Conduits 1-1/2" and larger characters..... 1"
- B. Markers shall identify voltage and functional use of the conduit, such as "480 VOLT 3 PHASE", "EMERGENCY", "120/208 VOLT", "120 VOLT", "CONTROL", "INSTRUMENTATION", etc.

## **2.3 WIRE LABELS AND CABLE MARKERS**

- A. Wire labels for No. 4/0 AWG and smaller wires shall be vinyl film, self-laminating, adhesive wraparound type; W. H. Brady Co. B-292, Thomas & Betts WSL Series or approved equal.
- B. Cable markers for cables and wire labels for all conductors 250 KCM and larger shall be polyester film, non-adhesive, plate type designed for cable tie banding parallel to the cable/conductor.
- C. Wire and cable identification numbers shall be printer generated or typewritten on the labels and markers.
- D. Character size for cable identification numbers shall be a minimum of 1/8-inch high.
- E. Markers labels, number generation method, and attachment methods shall be subject to the approval of the Designer.

## **2.4 MEDIUM VOLTAGE POWER CIRCUIT IDENTIFICATION TAGS**

- A. Provide engraved stainless-steel tags with 1/8-inch-high characters.
- B. Cable identification shall include the following information:
  - 1. Installation date; e.g., "MM/YYYY"
  - 2. Conductor size and material; e.g., "1/0 CU"
  - 3. Cable type; e.g., "MV-105, 133% EPR"
  - 4. Source and destination; e.g., "XFMR T-22 to ATS-5"
  - 5. Feeder number designation as indicated on the Drawings; e.g., "FDR 32"

## **2.5 ARC FLASH HAZARD WARNING LABELS**

- A. Warning labels for electrical equipment shall be color printed, waterproof, Designer approved, and Contractor furnished and installed.
- B. Labels shall indicate "WARNING" using black lettering on an orange background. The remainder of the label shall have black letters on a white background.
- C. At a minimum, each label shall include the following:
  - 1. Equipment location

2. Source protective device name providing the protection (fed from)

NOTE: The protective device name shall use the designations of equipment on the Project Drawings rather than names assigned within the power system study software model.

3. Nominal system voltage
4. Arc flash boundary
5. Specific arc incident energy available
6. Bolted fault current available
7. Label date

NOTE: Print appropriate information on label based on the arc flash risk assessment report provided in accordance with Specification Section 260573 – Overcurrent Protective Device Coordination Study and Arc Flash Risk Assessment.

- D. Size of warning labels shall be:

1. Equipment main bus rating less than 400A: 3.5" x 5"
2. Equipment main bus rating 400A or more: 5" x 7"

## 2.6 COLOR CODE TAPE

- A. Each conductor, except control and signal conductors, shall be color coded with 3M No. 35 tape, 3/4" width, or colored insulation.

1. Color coding for 600-volt conductors shall be:

| <u>120/240V 1 Phase</u> | <u>120/208V 3 Phase</u> | <u>277/480V 3 Phase</u> |
|-------------------------|-------------------------|-------------------------|
| Phase A Black           | Phase A Black           | Phase A Brown           |
| Phase B Red             | Phase B Red             | Phase B Orange          |
| Neutral White           | Phase C Blue            | Phase C Yellow          |
| Equipment Ground Green  | Neutral White           | Neutral Gray            |
|                         | Equipment Ground Green  | Equipment Ground Green  |

2. Color coding for medium-voltage cables shall be:

4,160V 3 Phase  
Match existing color coding at the project site  
Equipment Ground Green

- B. Wiring to contacts powered from an external source shall be yellow.
- C. Conductors for direct current (DC) circuits shall be color coded red for positive (+) conductor and black for negative (-) conductor.

## 2.7 PANELBOARD CIRCUIT DIRECTORIES

- A. Each panelboard shall have a framed circuit directory card with a clear plastic covering mounted on the inside of the door.
- B. The directory card shall provide a space at least 1/4-inch high by 3 inches long, or the equivalent, for each circuit.

- C. The directory card shall be typed to identify the load fed by each circuit for compliance with NEC 408.4.

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- A. Degrease and clean surfaces to receive nameplates, markers, labels and color code tape.

### **3.2 NAMEPLATES**

- A. Nameplates shall be provided for each switchboard and switchboard circuit breaker or fusible switch and for each enclosed circuit breaker, panelboard, automatic transfer switch, control panel, terminal box, dimensioned pull box, dimensioned junction box, and local control station.
- B. Provide a nameplate with the following wording at the fire pump circuit breaker in main switchboard "MSB" and in emergency switchboard "MESB1" for compliance with NEC 695.4(B)(3)(c):

"FIRE PUMP  
DISCONNECTING MEANS"

- C. Nameplates shall be secured with an approved adhesive such as Goodyear "Pliobond" glue or stainless-steel machine screws in tapped holes. Self-tapping screws or sheet metal screws shall not be used.

### **3.3 CONDUIT MARKERS**

- A. Attach a conduit identification marker to each conduit at all termination points and at 20' intervals along the entire length of the conduit.
- B. Secure markers parallel to conduit in a readily visible location.

### **3.4 WIRE LABELS AND CABLE MARKERS**

- A. Power feeders, branch circuits, control and signal wires and cables shall be identified.
  - 1. Attach a wire identification label to each conductor of a circuit cable group at each termination point.
  - 2. Attach a cable identification marker to each circuit cable group at all termination entry points.
- B. Wire labels and cable markers shall identify each conductor and cable with the circuit number. Identify with branch circuit or feeder number for power circuits and with control wire or cable number as indicated on schematic and interconnection diagrams and equipment shop drawings for control wiring.
- C. Cable markers for cables and wire labels for all conductors 250 KCM and larger shall be secured with heavy duty plastic cable ties. Cut excess tie material off flush with tie clasp. Do not leave sharp edges.

### **3.5 MEDIUM VOLTAGE POWER CIRCUIT IDENTIFICATION**

- A. Securely fasten identifying stainless-steel tags to the medium-voltage cables for Feeder 32 in existing pad-mounted transformer “T-22” and in existing 4.16 kV automatic transfer switchgear “ATS-5” using one-piece self-locking nylon cable ties. Cut off excess cable tie. Do not leave sharp edges.
- B. Install identification tags in locations where they are easily readable.

### **3.6 ARC FLASH HAZARD WARNING LABELS**

- A. Provide arc flash hazard warning labels in accordance with NEC Article 110-16 for the following equipment:
  - 1. All new and existing switchgear, switchboards, panelboards, motor control centers, low-voltage distribution transformers, motor controllers (motor starters), variable-frequency motor controllers (VFDs), enclosed switches (disconnect safety switches), enclosed circuit breakers on new diesel-engine-driven generator set, resistive load bank, generator connection cabinet and automatic transfer switches throughout the St. Louis Forensic Treatment Center - South, both inside and outside.
- B. Labels shall be applied to the outside of the front cover at the center of the cover such that the label is clearly visible with the door closed.
- C. Switchgear, switchboards, panelboards, and motor control centers having multiple sections shall have one 5” x 7” label applied to each section.
- D. Clean the surface to which each label is to be applied with denatured alcohol or a similar, fast evaporating cleaning agent that will not damage the paint finish.

### **3.7 COLOR CODE TAPE**

- A. Code all wire and cable not available color coded from manufacturer by application of electrical plastic tape in colors specified. Apply tape in uniform manner circling wire or cable. Half-lap tape for length of cable as required by Local Authorities or NEC but not less than five (5) full wraps.

### **3.8 JUNCTION, PULL, OUTLET AND DEVICE BOX IDENTIFICATION**

- A. Cover plates for all non-dimensioned junction and pull boxes shall be marked on the outside surface of the cover plate with the voltage, panel and circuit number of the branch circuit(s) contained inside the box. Marking shall be with printer generated “peel and stick” labels.
- B. Nameplates shall be provided on the external surface of the cover of all dimensioned junction and pull boxes which shall identify the source voltage of the circuits inside the box as well as the location of the AC power source(s) for these circuits.
- C. Cover plates for all receptacles shall be marked on the outside surface of the cover plate with panel and circuit number of the branch circuit serving the device. Marking shall be with printer generated “peel and stick” labels.



### **3.9 PANELBOARD CIRCUIT DIRECTORIES**

- A. Provide new “updated” directory cards for existing panelboards where indicated on the Drawings or in which circuits have been rearranged, added or deleted.
- B. Provide a directory card for all new panelboards furnished on this project.
- C. Each directory card shall be typewritten or printer generated to identify the load served by each circuit.
- D. Trace out unidentified circuits in existing panels and indicate load served on new circuit directory for compliance with NEC 408.4.

**END OF SECTION 260553**

# **SECTION 260573 –PROTECTIVE DEVICE COORDINATION STUDY AND ARC FLASH RISK ASSESSMENT**

## **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 SECTION INCLUDES**

- A. This Section includes computer-based fault-current, overcurrent protective device coordination and arc flash risk assessment studies, and the setting of these devices and application of proper arc flash hazard warning labeling to equipment.
  - 1. Coordination Study Report shall include: Short circuit analysis, time current characteristics for all protective devices, graphical demonstration of selectivity, relay and overcurrent protection device instruction books, and pertinent manufacturer data, and Missouri registered Professional Engineer seal and signature.
  - 2. Arc flash risk assessment report, with Missouri registered Professional Engineer seal and signature.
  - 3. Series ratings of protective devices are not acceptable unless specifically authorized by the Engineer for existing equipment. These situations will be addressed on a case-by-case basis.

### **1.3 RELATED SECTIONS**

- A. Section 260500 – Common Work Results for Electrical
- B. Section 260553 – Identification for Electrical Systems
- C. Section 262413 – Switchboards
- D. Section 262416 – Panelboards
- E. Section 262813 – Fuses
- F. Section 262816.13 – Enclosed Circuit Breakers
- G. Section 263213.13 – Diesel-Engine-Driven Generator Set
- H. Section 263236 – Resistive Load Bank (Alternate Bid No. 2)
- I. Section 263290 – Generator Connection Cabinet
- J. Section 263623 – Automatic Transfer Switches, Open Transition
- K. Section 263623.13 – Automatic Transfer Switches, Closed Transition (Alternate Bid No. 1)
- L. Section 263623.16 – Automatic Transfer Switch for Fire Pump

## 1.4 SUBMITTALS

- A. Study documentation
  - 1. Product Certificates: For coordination study and fault-current study computer software programs, certifying compliance with IEEE 399
  - 2. Qualification Data: For fault-current study and arc flash risk assessment specialist who shall be a professional engineer registered in the State of the Missouri
  - 3. Demonstrate experience with Arc Flash Risk Assessment by submitting names of at least three actual Arc Flash Risk Assessments performed in the past year.
  - 4. Demonstrate capabilities in providing equipment, services, and training to reduce Arc Flash exposure.
  - 5. Demonstrate experience in providing equipment labels in compliance with NFPA 70 (2020 edition), Article 110 and ANSI Z535.4 to identify AFIE and appropriate Personal Protective Equipment classes.
  - 6. Single-line diagram
    - a. Include as installed cable/conductor lengths, size and number of conductors for each circuit segment.
  - 7. Fault-current study report
  - 8. Coordination study report including completed computer program input data sheets
  - 9. Equipment evaluation report
  - 10. Overcurrent protective device settings report
  - 11. Arc flash risk assessment report
- B. Submit an electronic copy of the fault-current, overcurrent protective device coordination, and arc flash risk assessment studies for review and comment prior to or along with all submittals related to new overcurrent protective devices to be furnished on this project; medium-voltage vacuum circuit breakers, low-voltage circuit breakers, fuses, etc.
- C. Final report
  - 1. Provide two (2) bound copies of the approved fault-current, overcurrent protective device coordination, and arc flash risk assessment studies bound in 8-1/2 inch by 11-inch volumes with drawings and diagrams folded to fit the 8-1/2 inch by 11-inch format, sealed and signed by licensed Missouri Professional Engineer. Report cover shall be extra heavy weight paper (80 lb or heavier). Report data shall be printed on 8-1/2 inch by 11-inch paper. Diagrams, drawings, and coordination curves shall be printed on 11 inch by 17-inch paper unless larger size drawings, 36" x 42" maximum size, are required for legibility. Securely retain larger size drawings by folding and placing in pockets bound into report.
  - 2. Provide one complete copy of all report documentation on CD to include all data files, drawings and diagrams. File types for the report documentation should be .doc, .pdf, .dwg, or .xls. In addition, provide complete study files, in the native SKM software format, on CD to include all models, data, single lines, etc.
- D. General report requirements:

1. Include all facility power distribution system equipment located at the St. Louis Forensic Treatment Center - South, both inside and outside.
  2. Provide identification and description of industry testing standards on which study is based, for each section of study.
  3. Provide calculations, impedance diagrams, conclusions, and recommendations as part of study general content.
  4. Provide short circuit tabulations which include system impedances, X/R ratio, asymmetry factor, kVA, and symmetrical and asymmetrical fault currents.
  5. Provide each study with following:
    - a. Coordination plots which graphically indicate coordination proposed for several systems. Provide plots centered on full scale log-log-forms.
    - b. Coordination plots with complete titles, representative one-line diagrams and legends, associated power company's system characteristics, significant motor starting characteristics, complete parameters for power, fuses, if applicable, and associated system load protective devices.
    - c. Coordination plots which define types of protective devices selected, with proposed coil taps, time dial settings, and pick-up settings required.
    - d. Long time region of coordination plots shall indicate complete tap scale for each protective relay and full load current transformer parameters and designate pick-ups required for low voltage circuit breakers.
    - e. Short time region shall indicate low voltage circuit breaker, short time and instantaneous trip devices, fuse manufacturing tolerance bands, when applicable, and significant symmetrical and asymmetrical fault currents.
  6. Coordinate each item of equipment as follows:
    - a. Separate low voltage power circuit breakers from each other by 16 percent current margin for coordination and protection in event of secondary line-to-line faults.
    - b. Overcurrent protective devices serving the essential electrical system shall be coordinated for the period of time that a fault's duration extends beyond 0.1 second in accordance with Article 517 of the NEC.
    - c. Terminate protective device characteristics or operating band to reflect actual symmetrical and asymmetrical fault currents sensed by device.
    - d. Prepare study with network analyzer or computer. Manual calculations are not acceptable. Include complete fault calculations as specified for each proposed and ultimate source combination.
    - e. Source combinations include proposed and future large motors or generators.
- E. Drawings and specifications indicate general requirements for motors, motor starter equipment, and low voltage equipment. Determine additional specific characteristics of equipment furnished in accordance with results of short circuit and protective device coordination study.
1. Short circuit protective device coordination and arc flash study shall be coordinated with Contractor provided equipment shop drawings and existing conditions.

2. Submit equipment design discrepancies and proposed corrective modifications, if required, with short circuit and protective device coordination study. Identify variations clearly on shop drawings.
3. Provide equipment, overcurrent devices, field settings, adjustments and minor modifications for conformance with approved short circuit and protective device coordination study.
4. Identify existing equipment that is overstressed with recommended solution, including series rating of the equipment if that is possible.

## **1.5 APPLICABLE STANDARDS**

A. The latest edition of the following industry standards shall apply to the work specified herein.

1. ANSI/IEEE C37.46 – Power Fuses and Fuse Disconnecting
2. ANSI/IEEE C37.50 – Low-Voltage AC Power Circuit Breakers Used in Enclosures -- Test Procedures
3. ANSI Z535.4 – Product Safety Signs and Labels, Includes Errata
4. ICEA P-32-382 – Short Circuit Characteristics of Insulated Cable
5. ICEA P-45-482 – Short Circuit Performance of Metallic Shields and Sheaths on Insulated Cables
6. IEEE 141 – IEEE Recommended Practice for Electric Power Distribution for Industrial Plants (IEEE Red Book)
7. IEEE 242 – IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems (IEEE Buff Book)
8. IEEE 399 – IEEE Recommended Practice for Power Systems Analysis (IEEE Brown Book)
9. IEEE 446 – IEEE Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications (IEEE Orange Book)
10. IEEE 1015 – IEEE Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems (IEEE Emerald Book).
11. IEEE 1584 – IEEE Guide for Performing Arc Flash Calculations, Includes Amendments and Errata
12. NFPA 70 – National Electrical Code
13. NFPA 70B – Recommended Practice for Electrical Equipment Maintenance
14. NFPA 70E – Standard for Electrical Safety in the Workplace
15. International Electrical Testing Association, Inc. (NETA) – Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems

## **1.6 QUALITY ASSURANCE**

- A. Studies shall use licensed computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.
- B. Coordination-Study Specialist Qualifications: An organization experienced in the application of computer software used for electrical short circuit analysis and coordination studies having performed successful studies of similar magnitude on electrical distribution systems using similar devices. The coordination study shall be performed by a project state registered professional electrical engineer, in accordance with ANSI/IEEE Standard 242,

"Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems."

- C. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association to supervise testing specified herein.
- D. Comply with IEEE 399 for general study procedures.
- E. Comply with IEEE 242 for short-circuit currents and coordination time intervals.

## **1.7 ACCEPTABLE STUDY PROVIDERS**

- A. Protective Device Coordination Study and Arc Flash Risk Assessment Report Provider: Subject to compliance with requirements, study shall be commissioned by Division 26 and provided by supplier of the new emergency switchboard per Section 262413 – Switchboards or other qualified Missouri registered professional engineer subject to approval of the Designer.

## **1.8 COMPUTER SOFTWARE PROGRAM**

- A. Computer Software Program: Subject to compliance with requirements, the protective device coordination study and arc flash risk assessment shall be provided using the latest version of SKM Power Tools Electrical Engineering Software (PTW 32) by SKM Systems Analysis, Inc., or approved equal by ESA, Inc. or CYME International, Inc.

## **1.9 COMPUTER SOFTWARE PROGRAM REQUIREMENTS**

- A. Computer software program must comply with IEEE 399.
- B. Analytical features of fault-current-study computer software program shall include "mandatory", "very desirable", and "desirable" features as listed in IEEE 399, Table 7-4.
- C. Computer software program shall provide plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices.
  - 1. Additional Program Features:
    - a. Arcing faults
    - b. Simultaneous faults
    - c. Explicit negative sequence
    - d. Mutual coupling in zero sequence
    - e. Arc flash risk assessment

## **1.10 EXAMINATION**

- A. Examine protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated shall be as indicated on the one-line diagrams on the Drawings.
- B. Proceed with coordination study only after relevant equipment submittals have been assembled. Protective devices not submitted for approval with coordination study may not

be used in study. Protective devices submitted prior to this coordination study will be reviewed, but final approval will be contingent upon the study results.

- C. Field verify all information shown on the electrical one-line diagrams, including but not limited to:
  - 1. Ratings of existing equipment
  - 2. Transformer ratings and impedances
  - 3. Overcurrent protective device sizes/ratings
  - 4. Conductor types and sizes
  - 5. Conduit types (magnetic or non-magnetic)
  - 6. Feeder lengths
- D. Update project one-line diagrams with information obtained from field verifications

#### **1.11 FAULT-CURRENT STUDY**

- A. Fault study shall incorporate the available fault current information indicated in the Ameren Missouri fault data report included in Attachment A to this specification section.
  - 1. Verify the accuracy of this information by contacting to obtain an updated copy:  
Ameren Missouri Construction Services  
866-992-6619  
[servicerequest@ameren.com](mailto:servicerequest@ameren.com)
- B. Study electrical distribution system for all Ameren Missouri sources and all Ameren source switching scenarios as well as for the alternate source (diesel-engine-driven generator per Section 263213.13 – Diesel-Engine-Driven Generator Set) using an approved computer software program to calculate values in order to determine the maximum fault conditions.
- C. Calculate momentary and interrupting duties based on the maximum available fault current.
- D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with the following:
  - 1. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.50
  - 2. Low-Voltage Fuses: IEEE C37.46
  - 3. Circuit Breakers: IEEE C37.13
- E. Fault study must be completed and submitted prior to proceeding with procurement/manufacturing of any of the following new equipment:
  - 1. Equipment Branch Emergency Switchboard under Section 262413 – Switchboards
  - 2. Circuit breaker panelboard under Section 262416 - Panelboards
  - 3. Diesel-Engine-Driven Generator Set output circuit breakers under Section 263213.13 – Diesel-Engine-Driven Generator Set
  - 4. Resistive Load Bank under Section 263236 – Resistive Load Bank
  - 5. Generator Connection Cabinet under Section 263290 – Generator Connection Cabinet

6. Automatic Transfer Switches under Section 263626 – Automatic Transfer Switches
  7. Fire Pump Automatic Transfer Switch under Section 263623.13 – Automatic Transfer Switch for Fire Pump
- F. Study Report: Enter calculated X/R ratios and interrupting (5-cycle) fault currents on electrical distribution system diagram of the report. List other output values from computer analysis, including monetary (1/2-cycle), interrupting (5-cycle), and 30-cycle fault-current values for 3-phase, 2-phase, and phase-to-ground faults.
- G. Equipment Evaluation Report: Prepare a report on the adequacy of protective devices and conductors by comparing fault-current ratings of these devices with calculated fault-current momentary and interrupting duties. Identify existing equipment that is overstressed with recommended solution, including series rating of the equipment if that is possible. If series ratings for protection of existing electrical equipment are approved by the Engineer, provide caution labels for all series rated equipment for compliance with NEC 240.86 and 110.22(B) or (C).
1. Equipment evaluation report shall include all facility power distribution system equipment located at the St. Louis Forensic Treatment Center - South, both inside and outside.

## **1.12 COORDINATION STUDY**

- A. The final approved settings shall incorporate the results of the Arc Flash Risk Assessment to minimize the hazard associated with the related systems.
- B. Gather and tabulate the following input data to support coordination study:
1. Product Data for overcurrent protective devices specified in other Division 26 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. Electrical distribution system diagram showing the following:
    - a. Load current that is the basis for sizing continuous ratings of circuits for cables and equipment
    - b. Circuit-breaker and fuse-current ratings and types
    - c. Transformer kilovolt amperes, primary and secondary voltages, connection types, impedance, and X/R ratios
    - d. Cables: Indicate conduit material, sizes of conductors, conductor insulation, and length
    - e. Motor horsepower and code letter designation according to NEMA MG 1
  3. Study specialist must visit the project site to field verify the information shown on the project drawings and to confirm the lengths of existing feeders to a reasonable level of accuracy.
  4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram



- a. Special load considerations, including starting inrush currents and frequent starting and stopping
  - b. Magnetic inrush current overload capabilities of transformers
  - c. Motor inrush current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve
  - d. Time-current characteristic curves of devices indicated to be coordinated
  - e. Manufacturer, frame size, interrupting rating in amperes RMS symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers
  - f. Switchgear, switchboards, panelboards, motor control centers, low-voltage distribution transformers, motor controllers (motor starters), variable-frequency motor controllers (VFDs), enclosed switches (disconnect safety switches), circuit breakers, resistive load bank, generator connection cabinet and automatic transfer switches and interrupting rating in amperes rms symmetrical
- C. Perform coordination study and prepare a written report using the results of fault-current study and approved computer software program. Comply with IEEE 399.
- D. Comply with NFPA 70 for overcurrent protection of circuit elements and devices.
- E. Comply with IEEE 141 and IEEE 242 time intervals.
- F. Transformer Primary Overcurrent Protective Devices:
  - 1. Device shall not operate in response to the following:
    - a. Self-cooled, full-load current for the transformer.
    - b. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
  - 2. Device shall protect transformer according to IEEE C57.12.00, for fault currents.
- G. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Verify adequacy of phase conductors at maximum three-phase bolted fault currents, equipment grounding conductors, and grounding electrode conductors at maximum ground-fault currents.
- H. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:
  - 1. Tabular Format of Settings Selected for Overcurrent Protective Devices:
    - a. Device tag
    - b. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings
    - c. Fuse-current rating and type
    - d. Ground-fault relay pickup and time-delay settings
    - e. Medium-voltage protective relay settings

2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between series devices, including existing upstream devices. Show the following specific information:
  - a. Device tag
  - b. Voltage and current ratio for curves
  - c. Three-phase and single-phase damage points for each transformer
  - d. No damage, melting, and clearing curves for fuses
  - e. Cable damage curves
  - f. Transformer inrush points
  - g. Maximum fault-current cutoff point
3. Study shall include a narrative identifying any potential coordination short falls and recommendations for change.
4. Completed data sheets for setting of overcurrent protective devices

### **1.13 OVERCURRENT PROTECTIVE DEVICE SETTINGS**

- A. Manufacturer's Field Service: Engage a factory-authorized service representative, of electrical distribution equipment being set and adjusted, to set overcurrent protective devices within equipment.
- B. Testing: Perform the following device setting and prepare reports:
  1. After installing overcurrent protective devices and during energizing process of electrical distribution system, perform the following:
    - a. Verify that overcurrent protective devices meet parameters used in studies.
    - b. Adjust devices to values listed in study results, if overcurrent protective devices are adjustable.
    - c. "Seal" each relay/adjustable circuit breaker setting access cover with an approved sealing device, Square D "TUSEAL" or approved equal, to prevent unauthorized changes to settings.
  2. Adjust devices according to recommendations in Chapter 7, "Inspection and Test Procedures", and Tables 10.7 and 10.8 in NETA "Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems".

### **1.14 ARC FLASH RISK ASSESSMENT**

- A. Gather and tabulate the information provided by the Short Circuit Analysis and the Coordination Study, for the preparation of the Arc Flash Risk Assessment.
- B. The intent of the Arc Flash Risk Assessment is to achieve the lowest possible hazard ratings for the associated equipment while still maintaining the code required level of electrical coordination for the system. The results of the risk assessment shall be incorporated into the recommended protective device settings to minimize the arc flash hazard.
- C. Scope of Work:

1. Provide arc flash risk assessment warning labels in accordance with NEC Article 110-16 for the following equipment:
  - a. All new and existing switchgear, switchboards, panelboards, motor control centers, low-voltage distribution transformers, motor controllers (motor starters), variable-frequency motor controllers (VFDs), enclosed switches (disconnect safety switches), enclosed circuit breakers on new diesel-engine-driven generator set, resistive load bank, generator connection cabinet and automatic transfer switches located throughout the St. Louis Forensic Treatment Center - South, both inside and outside

D. Arc Flash Risk Assessment:

1. The Arc Flash Risk Assessment shall be performed with the aid of computer software intended for this purpose in order to calculate Arc Flash Incident Energy (AFIE) levels and flash protection boundary distances.
2. The Arc Flash Risk Assessment shall be performed in conjunction with a short-circuit analysis and time-current coordination analysis.
3. Results of the Arc Flash Risk Assessment shall be submitted in tabular form, and shall include device or bus name, bolted fault and arcing fault current levels, flash protection boundary distances, personal-protective equipment classes and AFIE levels.
4. The Arc Flash Risk Assessment shall be performed under worst-case arc flash conditions, and the final report shall describe, when applicable, how these conditions differ from worst-case bolted fault conditions.
5. The Arc Flash Risk Assessment shall be performed by a professional engineer who is currently registered in the State of Missouri.
6. The Arc Flash Risk Assessment shall be performed in compliance with the latest edition of IEEE Standard 1584, the IEEE Guide for Performing Arc Flash Calculations including any and all addendums and errata.
7. The Arc Flash Risk Assessment shall include recommendations for reducing AFIE levels and enhancing worker safety.
8. Prior to final approval, incorporate actual installed cable/conductor lengths into the Arc Flash Risk Assessment.

E. Comply with NFPA 70, NFPA 70E, and NFPA 70B standards for the Arc Flash Risk Assessment Report.

F. Field Labeling and Signage:

1. Provide complete arc flash hazard warning signage per NFPA 70 Article 110-16 and ANSI Z535.4 at each switchgear, switchboard, panelboard, motor control center, low-voltage distribution transformer, motor controller (motor starter), variable-frequency motor controller (VFD), enclosed switch (disconnect safety switch), enclosed circuit breaker on new diesel-engine-driven generator set, resistive load bank, generator connection cabinet, automatic transfer switch, and other equipment if/as required by National Electrical Code (NEC) and/or NFPA 70E requirements.
2. Arc flash hazard warning labels shall be provided in accordance with Section 260553 – Identification for Electrical Systems.

3. The source protective device name providing the protection (fed from) on each arc flash hazard warning label shall use the designations of equipment shown on the Project Drawings rather than names assigned within the power system study software model.

#### **1.15 COORDINATION OF WORK**

- A. Adjustment of protective device equipment to meet the approved protective device coordination submittal shall be the responsibility of Division 26 at no additional cost to the Owner.

#### **1.16 ARC FLASH TRAINING**

- A. The arc flash study provider shall train the Owner's personnel on the potential arc flash hazards associated with working on energized electrical equipment. The audience shall include employees who work on or near energized electrical equipment, who must be made aware of the associated electrical hazards. The training shall be conducted at the Owner's facility and shall be a minimum of 1 hour and a maximum of 2 hours in duration.
- B. The intent of this training is not to "certify" or "qualify" the Owner's maintenance personnel to work on energized electrical equipment or provide an adequate level of training for them to meet the NFPA 70E definition of a "qualified person" but rather to give them a broad understanding of the purpose of arc flash hazard warning labeling and an awareness of the dangers of working on or near energized electrical equipment.
- C. A key purpose of the training is to help the attendees become aware of potential shock and arc flash hazards associated with energized electrical equipment and ways to mitigate the risk of injury associated with these hazards.
- D. It is not the intent of this training to provide electrical equipment preventative maintenance training.

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

#### **PART 3 - EXECUTION (Not Applicable)**

#### **END OF SECTION 260573**

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## **ATTACHMENT A**

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Date: 1/28/2020

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## Fault Level Request Data

### Utility Contact Information

Name: Dave Everding  
Phone: (314)992-9726  
Email: deverding@ameren.com

### Customer Information

Service Address: 5200 Arsenal  
Meter #: 02664625  
Supply Voltage: 4.16kV

### Fault Analysis

Fault location: Primary Meter  
Fault Voltage: 4.16kV  
3ph fault current: 7,429 A  
System X / R ratio: 3.51  
L-G fault current: 6,009 A  
System  $X_0$  /  $R_0$  ratio: 2.53

### Transformer Information

TLM #: 01550390002  
Voltages: 4.16kV primary meter  
KVA capacity: NA  
Impedance %Z: NA

### Primary protection device

#### Fuse

#### Relay / Breaker

Make: ABB  
Model: CO-11  
Pickup: 8 x 120CTR  
Curve: CO-11  
Time Dial: 1.07  
Trip info: 5 cycles

Note: The fault current values provided are calculated values, based on the current state of the system and the service configuration proposed or provided to the customer's equipment. Given the dynamic nature of the distribution system, the possibility always exists for the available fault current values to increase or decrease (i.e. changes in the distribution system, feeder and/or substation assignments, or substation configurations). Additionally, this calculated fault current does not include any contributions by customer motors, either upstream or downstream of the service connection point, or fault current asymmetry. This fault calculation accounts for the current utility contribution only. Ameren Missouri personnel shall not be held responsible for any damage to property or person resulting from the use of this data.

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## SECTION 260583 – WIRING CONNECTIONS

### 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 SCOPE

- A. The Contractor shall furnish and install all wiring connectors and terminations for 600-volt building wire, 600-volt multi-conductor control cable, 600-volt shielded instrumentation cable and CAT 6 Ethernet cable as specified herein and as shown on the Drawings.

#### 1.3 RELATED SECTIONS

- A. Section 260500 – Common Work Results for Electrical
- B. Section 260519 – Low-Voltage Electrical Conductors and Cables
- C. Section 260526 – Grounding and Bonding for Electrical Systems
- D. Section 260533.16 – Boxes for Electrical Systems
- E. Section 262413 – Switchboards

#### 1.4 SUBMITTALS

- A. Manufacturer's product data sheets shall be submitted for each of the following items:
  - 1. 600-volt connectors
  - 2. 600-volt terminations and splices
  - 3. 600-volt in-line splice insulating materials
  - 4. 600-volt terminal blocks, including accessories
  - 5. CAT 6 copper Ethernet connectors

### PART 2 - PRODUCTS

#### 2.1 600-VOLT CONNECTIONS AND TERMINATIONS

- A. Pressure Type Terminal and Splice Connectors: Solderless, color coded, nylon insulated, pressure type, UL Listed 105°C, 600-volt, sized for the cable to be terminated or spliced, tin-plated copper, with crimping tool coded to the connectors with stops to prevent over-crimping and means to prevent under-crimping; 3M Scotchlok or approved equal.
- B. Spring Type Splice Connectors: Solderless, color coded, flame retardant polypropylene and thermoplastic elastomer or flame retardant nylon, spin-on wings, spring steel inner spring with corrosion resistant coating, UL Listed 105°C, 600-volt, sized for splicing two or more conductors up to size 6 AWG; 3M Performance Plus or approved equal.

- C. *Control Wiring Connections and Termination:* Control wiring connectors shall be vinyl or nylon pre-insulated spade lugs to match stud or screw size with insulation grip sleeve flared to prevent turned-back strands and crimping tool to crimp wire barrel and insulation sleeve.
1. Where attachment is to a terminal block screw or stud, install using pre-insulated spade type connectors.
  2. Conductor to conductor splices shall be made using wire nuts or wing nuts only wrapped with a minimum of three (3) half-lapped layers of jacketing tape specified. No crimp type connectors shall be used for these types of splices.
- D. *Power Connections, Terminations and Splice Connectors:*
1. Size 12 AWG through 2/0 AWG connectors shall be non-insulated, one-hole rectangular tongue, for copper conductors, UL Listed 90°C, 600-volt.
  2. Size 3/0 AWG and larger conductors shall be non-insulated, two-hole rectangular tongue with long barrel length to permit two (2) crimps for copper conductors, UL Listed 90°C, 600-volt.
  3. Feeder tap splices shall only be made where specifically indicated on the Drawings or where pre-approved by the Designer.
    - a. Spring type splice connectors as specified herein. For size 6 AWG and smaller conductors only.
    - b. Multiple tap mechanical type connectors for size range 12 AWG to 500 KCM. Burndy UNITAP Catalog No. BIBSxxxxDB or approved equal by Blackburn, IlSCO or Polaris.
    - c. Multiple tap compression type connectors for size range 14 AWG to 750 KCM. Burndy "H" Shape Copper Tap Catalog No. YHxxxx with flame retardant cover or approved equal by Blackburn or IlSCO.
  4. In-line feeder splices shall only be made where specifically indicated on the Drawings or where pre-approved by the Designer.
    - a. Size 12 AWG through 2/0 AWG connectors, for splicing like sized conductors, shall be non-insulated, standard-length barrel, for copper conductors, UL Listed 90°C, 600-volt, compression type.
    - b. Size 3/0 AWG and larger connectors, for splicing like sized conductors, shall be non-insulated, long-length barrel to permit two (2) crimps on each conductor, for copper conductors, UL Listed 90°C, 600-volt.
    - c. For splicing smaller copper conductors to larger copper conductors, utilize non-insulated, UL Listed 90°C, 600-volt, compression type kit with heat shrink insulating tube; Burndy Catalog No. YSRxxxxxxxxxKITC or approved equal by Blackburn or IlSCO.
- E. *Power Termination and In-Line Splice Insulation:*
1. Insulating Putty: 3M Scotchfil electrical insulating putty or approved equal by Thomas & Betts
  2. Insulating Tape: 3M Scotch 23 or Thomas & Betts Shrink-Kon TBFT201-36 self-fusing insulating tape
  3. Jacketing Tape: 3M Scotch 33+ jacketing tape
  4. Provide pre-engineered insulating kits by 3M or Thomas & Betts where appropriate.

5. For in-line splices, provide pre-engineered cold shrink or heat shrink insulating kits by 3M, Raychem, or Thomas & Betts in lieu of tape insulation, when available.

F. Terminal Blocks:

1. DIN rail mounted, UL Listed, 600-volt, finger safe, high density modular style, compression type, IEC terminal blocks, rated for a minimum of 20 amps of AC current and sized as required based on the conductor sizes to be terminated.
2. Provide all required accessories to make a complete terminal block assembly. Accessories shall include but not be limited to:
  - a. DIN mounting rail (symmetrical aluminum)
  - b. End anchors (heavy-duty type)
  - c. End barriers
  - d. Center type jumper bars (Jumpering of live voltages using non-insulated comb type jumpers will not be acceptable.)
3. Each terminal on the terminal blocks shall be plainly and permanently marked with printer generated, plastic, snap-on markers. Wire labels shall not be used to identify terminals on terminal blocks.
4. Terminal block assemblies shall include 50% spare terminals of each size and type used. Terminal blocks shall be Allen-Bradley Bulletin 1492, W or J Series or approved equal.

## **2.2 CAT 6 COPPER ETHERNET CABLE CONNECTIONS**

- A. RJ-45, 8-pin compression type with locking tab meeting the requirements of ANSI/TIA-568-C.2 with snag-proof strain relief, field installable connector compatible with the cable onto which installed.

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- A. Conductors shall be continuous from source to destination without splices or taps in conduit runs, except where indicated on the Drawings to compensate for voltage drop or where required to prevent excessive pulling tension or sidewall pressure on wire or cable. Submit all proposed splice locations to the Engineer for approval prior to pulling wire and cable. Where permitted, splices shall be mechanically strong and have an insulation value equal to the wire or cable being spliced. All splices and taps shall be contained within NEC sized junction boxes meeting the requirements of Section 260533.16 – Boxes for Electrical Systems.

### **3.2 CONTROL WIRING CONNECTIONS AND TERMINATIONS**

- A. Thoroughly clean wires before installing connectors.
- B. Tape back spare conductors with 3M Scotch 33+ jacketing tape.
- C. Where attachment is to a terminal block screw or stud, install using pre-insulated spade type connectors.

- D. Where control cable terminations are split across terminal blocks or are otherwise separated by more than 12 inches distance, identify each conductor group with the circuit number as specified in Section 260553 – Identification for Electrical Systems.
- E. Conductor to conductor splices shall be made using wire nuts or wing nuts. No crimp type connectors shall be used for these types of splices.
  - 1. Apply a minimum of three (3) half-lapped layers of jacketing tape over each and every spring type (wire nut) splice connection.
- F. Conductor to conductor splices in instrumentation wiring shall be made using IEC finger-safe, DIN rail mounted terminal blocks in a junction box with inner back panel in accordance with Section 260533.16 – Boxes for Electrical Systems.

### **3.3 600-VOLT CONNECTIONS AND TERMINATIONS**

- A. Cut conductors to proper length such that the barrel or inner metal spring of the connector makes full contact with the bare conductor and not the insulation and the plastic skirt of the connector full covers the bare conductor.
  - 1. Conductor to conductor splices for size 10 AWG or smaller conductors shall be made using wire nuts or wing nuts. No crimp type connectors shall be used for these types of splices.
  - 2. Apply a minimum of three (3) half-lapped layers of jacketing tape over each and every spring type (wire nut) splice connection.
- B. Power Connections and Terminations:
  - 1. Cover all exposed live parts such as connectors, bolts, nuts, and bus bar with insulating material to equal or exceed insulation of the connected cable.
  - 1. At equipment with cable leads such as motors, install compression type terminal connectors on equipment leads and power circuit leads, bolt together, and insulate with pre-engineered motor terminal kits or as specified herein.
  - 2. At equipment with integral set screw or clamp type connectors such as terminal blocks and molded case circuit breakers, strip conductor insulation as required to clear contact surfaces, and torque connector in accordance with manufacturer's recommendations.

### **3.4 600-VOLT POWER TERMINATION AND IN-LINE SPLICE INSULATION**

- A. Insulate with pre-engineered cold shrink or heat shrink kits when available, or with a minimum of three (3) half-lapped layers of insulating tape covered with three (3) half-lapped layers of jacketing tape.
- B. Provide electrical insulating putty to fill major irregularities and voids in termination prior to application of insulating tape.
- C. Apply self-fusing insulating tape directly to the conductors or over the electrical insulation putty.
- D. Apply jacketing tape over the insulating tape to provide an outer covering for the cable termination.

- E. Splices made using spring type splice connectors shall be insulated with a minimum of three (3) half-lapped layers of jacketing tape specified.

### **3.5 CAT 6 COPPER ETHERNET CABLE TERMINATIONS**

- A. Utilize the connector manufacturer's recommended installation tool(s) for cutting, stripping and crimping cable and inserting into the connector.

### **3.6 FIELD QUALITY CONTROL**

- A. General:
  - 1. Testing shall be performed in the presence of Construction Representative. Contractor must provide 48 hours' notice prior to conducting tests.
  - 2. Prepare a test report upon completion of testing activities. Report format shall include the following information:
    - a. Summary of test results
    - b. Test equipment summary (model number, accuracy, calibration date)
    - c. Test personnel names and signoffs
    - d. Completed data sheets
    - e. Test log and observations
    - f. Certificate of Compliance
- B. Torque test conductor connections and terminations to manufacturer's recommended values.
- C. Provide testing for 600-volt wire and cable in accordance with Section 260519 – Low-Voltage Electrical Power Conductors and Cables in conjunction with the testing specified herein.

**END OF SECTION 260583**

# **SECTION 230900 – INSTRUMENTATION AND CONTROL FOR ELECTRICAL SYSTEMS**

## **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. This Section includes the requirements for interfacing new electrical equipment to the existing building automation system (BAS).

### **1.3 RELATED SECTIONS**

- A. Section 260500 – Common Work Results for Electrical
- B. Section 262416 – Panelboards
- C. Section 262816.13 – Enclosed Circuit Breakers
- D. Section 263213.13 – Diesel-Engine-Driven Generator Set
- E. Section 263623 – Automatic Transfer Switches, Open Transition
- F. Section 263623.13 – Automatic Transfer Switches, Closed Transition (Alternate Bid No. 1)
- G. Section 263623.16 – Automatic Transfer Switch for Fire Pump

### **1.4 GENERAL**

- A. Control systems shall be fully coordinated and integrated with associated electrical equipment and systems that are to be controlled and/or monitored.
- B. Obtain all field information (dimensions, clearances, sizes, quantities, construction details, etc.) as required to properly complete the Work.
- C. Control system subcontractor shall complete site visits as required to coordinate control system design with existing conditions and the new electrical equipment to be monitored.
- D. Submittals shall include control plans indicating the proposed location of all control panels to receive modification and/or where new cables are to be connected.

### **1.5 DEFINITIONS**

- A. Algorithm:
  - 1. A logical procedure for solving a recurrent mathematical problem.
  - 2. A prescribed set of well-defined rules or processes for solving a problem in a finite number of steps.

- B. Analog: A continuously varying signal value that represents control influences such as current, flow, level, moisture, pressure, and temperature.
  - 1. AI: Analog Input
  - 2. AO: Analog Output
- C. BAS: Building Automation System
- D. Binary: Two-state signal where a high signal level represents an “ON” or “OPEN” condition and a low signal level represents an “OFF” or “CLOSED” condition. Binary signals convert electronic signals to digital pulses (values) and generally represent two-position operating and alarm status. “Digital” is sometimes used interchangeably with “Binary” to indicate a two-state signal.
- E. Controller: Generic term for any stand-alone, microprocessor-based, digital controller residing on a network, used for local or global control. Three types of controllers are indicated: Network Controller, Programmable Application Controller, and Application Specific Controller.
- F. Control System Integrator: An entity that assists in expansion of existing enterprise system and support of additional operator interfaces to I/O being added to existing enterprise system.
- G. DDC: Direct digital control
- H. BAS Provider: Authorized representative of, and trained by, BAS manufacturer and responsible for execution of BAS modifications indicated.
- I. Distributed Control: Processing of system data is decentralized and control decisions are made at subsystem level. System operational programs and information are provided to remote subsystems and status is reported back. On loss of communication, subsystems shall be capable of operating in a standalone mode using the last best available data.
- J. Digital: See “Binary”
  - 1. DI: Digital Input
  - 2. DO: Digital Output
- K. Gateway: Bidirectional protocol transfer that connects control systems that use different communication protocols
- L. HVAC: Heating, ventilation and air conditioning
- M. I/O: Input/Output – System through which information is received and transmitted.
  - 1. AI: Analog input
  - 2. BI: Binary input, sometimes used interchangeably with DI
  - 3. DI: Digital input, sometimes called “discrete input” and sometimes used interchangeably with BI
  - 4. AO: Analog output
  - 5. BO: Binary output, sometimes used interchangeably with DO

- 6. DO: Digital output, sometimes called “discrete output” and sometimes used interchangeably with BO
- N. LAN: Local area network
- O. Low Voltage: As defined in NFPA 70 (National Electrical Code) for circuits and equipment operating at less than 50-volts or for remote-control, signaling power-limited circuits.
- P. Modbus TCP/IP: An open protocol for exchange of process data.
- Q. Modbus RTU: RS-485 serial “remote terminal unit” protocol for exchange of data
- R. MS/TP: Master slave/token passing, IEEE 8802-3. Datalink protocol LAN option that uses twisted-pair wire for low-speed communication.
- S. Network Controller: Digital controller which supports a family of programmable application controllers and application-specific controllers, that communicates on peer-to-peer network for transmission of global data.
- T. Network Repeater: Device that receives data packet from one network and rebroadcasts it to another network. No routing information is added to protocol.
- U. PC: Personal computer
- V. Peer to Peer: Networking architecture that treats all network stations as equal partners.
- W. PID: Proportional plus integral plus derivative
- X. POT: Portable operator’s terminal
- Y. PUE: Performance usage effectiveness
- Z. RAM: Random access memory
- AA. RF: Radio frequency
- BB. Router: Device connecting two or more networks at network layer
- CC. Server: Computer used to maintain system configuration, historical and programming database.
- DD. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows
- EE. USB: Universal serial bus
- FF. User Datagram Protocol (UDP): Protocol that assumes that the IP is used as the underlying protocol.

## **1.6 ACTION SUBMITTALS**

- A. Product Data: For each type of product include the following:

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1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
  2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
  3. Product description with complete technical data, performance curves, and product specification sheets.
  4. Installation, operation and maintenance instructions including factors effecting performance.
  5. Bill of materials indicating quantity, manufacturer, and extended model number for each unique product, including but not limited to:
    - a. I/O expanders
    - b. Modbus RTU communication port expanders
    - c. Modbus RTU communication driver
  6. When manufacturer's product datasheets apply to a product series rather than a specific product model, clearly indicate and highlight only applicable information.
  7. Each submitted piece of product literature shall clearly cross reference specification and drawings that submittal is to cover.
- B. Control Plans: Control plans indicating the proposed location of all control panels to receive modifications and/or where new cables are to be connected.
- C. Coordination Plan: For each control system, list critical coordination activities to be completed with electrical equipment service representatives.
- D. Shop Drawings:
1. General Requirements:
    - a. Include cover drawing with Project name, location, Owner, Designer, Contractor and issue date with each Shop Drawings submission.
    - b. Include a drawing index sheet listing each drawing number and title that matches information in each title block.
    - c. Prepare Drawings using CAD.
    - d. Drawings Size: 11"x17", 22"x34" or 24"x36".
  2. Include plans, elevations, sections, and mounting details where applicable.
  3. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  4. Plan Drawings indicating the following:
    - a. Screened backgrounds of walls with structural grid lines showing all electrical equipment that have connections to the BAS for monitoring.
    - b. Room names and numbers with coordinated placement to avoid interference with control products indicated.

- c. Network communication cable and raceway routing.
  - d. Information, drawn to scale.
  - e. Proposed routing of wiring, cabling, and conduit, coordinated with building services for review before installation.
- 5. Schematic drawings for each electrical equipment item that is monitored indicating the following:
  - a. I/O points labeled with point names shown. Indicate alarm set points.
  - b. I/O listed in table format showing point name, type of device, manufacturer, model number, and cross-reference to product data sheet number.
  - c. A graphic showing location of I/O in proper relationship to electrical equipment.
  - d. Wiring diagram with each I/O point having a unique identification and indicating labels for all wiring terminals.
  - e. Unique identification of each I/O that shall be consistently used between different drawings showing same point.
  - f. Elementary wiring diagrams of monitored points for electrical equipment including dry contacts and Modbus RTU communications interfaces.
- 6. Monitoring signal diagrams indicating the following:
  - a. Wiring between monitored electrical equipment and BAS equipment.
  - b. Point-to-point schematic wiring diagrams for each product.
- 7. Color graphics indicating the following:
  - a. Itemized list of color graphic displays to be provided indicating monitored systems, data point addresses, output schedule, and operator notations.
  - b. For each display screen to be provided, a true color copy showing layout of pictures, graphics and data displayed.
  - c. Intended operator access between related hierarchical display screens.
- E. System Description:
  - 1. Complete listing and description of each report, log and trend for format and timing and events which initiate generation.
  - 2. Complete bibliography of documentation and media to be delivered to Owner.
  - 3. Description of testing plans and procedures.
  - 4. Description of Owner training.

## **1.7 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For system modifications designer, programmer and installer.
- B. Software Upgrade Kit: For Owner to use in modifying software to suit future systems revisions or monitoring and control revisions.
- C. Field quality-control, calibration, testing, and adjusting reports.

## **1.8 CLOSEOUT SUBMITTALS**

- A. As-built shop drawings, final system programming, and final system graphics.
- B. Operation and Maintenance Data: For all modification to the existing BAS to include in emergency, operation, and maintenance manuals. Data shall include, but not be limited to, the following:
  - 1. Maintenance instructions and lists of spare parts for each type of control device.
  - 2. Interconnection wiring diagrams with identified and numbered system components and devices.
  - 3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
  - 4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
  - 5. Calibration records and list of set points.
- C. Software and Firmware Operational Documentation: Include the following:
  - 1. Software operating and upgrade manuals.
  - 2. Program Software Backup: On a compact disc, DVD or USB thumb drive complete with data files.
    - a. Backup shall completely restore the system in the event of a computer malfunction.
  - 3. Device address list
  - 4. Printout of software application and graphic screens.
  - 5. Software license required by and installed for BAS workstations and control systems.
- D. Warranty Certificates

## **1.9 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish recommended spare parts and price list.

## **1.10 QUALITY ASSURANCE**

- A. BAS Provider/Installer Qualifications:
  - 1. Authorized representative of, and trained by BAS manufacturer, Tridium, Inc.
  - 2. In-place facility located within 60 miles of Project location.
  - 3. Demonstrated past experience with installation of BAS products being installed for period within 10 consecutive years before time of bid.
  - 4. Demonstrated past experience on five projects of similar complexity, scope and value.
  - 5. Service and maintenance staff assigned to support Project during warranty period.
  - 6. Product parts inventory to support on-going DDC system operation for a period of not less than 5 years after Substantial Completion.

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

## **1.11 WARRANTY**

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace products that fail in materials or workmanship within specified warranty period.
  - 1. Failures shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner.
  - 2. Include updates or upgrades to software, firmware and drivers if necessary to resolve deficiencies.
    - a. Install updates only after receiving Owner's written authorization.
  - 3. Hardware and software personnel supporting this warranty agreement shall provide on-site or off-site service in a timely manner upon failure notification. The maximum acceptable response time to provide this service at the site shall be 24 hours, Monday through Friday and 24 hours on Saturday and Sunday.
- B. Warranty shall cover all costs for parts, labor, associated travel, and expenses for a period of one year from date of substantial completion and formal system acceptance by Construction Representative in writing.
- C. The warranty shall apply equally to both hardware and software.

## **1.12 COORDINATION**

- A. Coordinate with control components included with equipment furnished by others.
- B. Coordinate with emergency system panelboards, diesel-engine-driven generator set, resistive load bank, generator connection cabinet, automatic transfer switches, and motor control centers to achieve compatibility control and/or monitoring interfaces.

## **PART 2 - PRODUCTS**

### **2.1 BUILDING AUTOMATION CONTROL SYSTEM**

- A. Existing Equipment: Niagara Series 4
- B. Installer/Service Provider: The present service provider for the existing Niagara 4 BAS is:  
  
Dynamic Controls Inc.  
2320 Ball Drive  
St. Louis, MO 63146  
Jimmy Gericke  
314-925-4809  
Jimmy.Gericke@dciusa.com
- C. The existing Niagara 4 BAS consists of operator interface equipment, communication systems, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control HVAC equipment and monitor electrical equipment.

## 2.2 CONTROL SYSTEM DESCRIPTION

- A. Integration of new electrical equipment with existing facility BAS for monitoring, annunciating and alarming as follows:
  - 1. New emergency generator control panel via Modbus RTU
  - 2. New fire pump automatic transfer switch ATS-1, located in the Fire Protection Room C123A, via Modbus RTU
  - 3. New automatic transfer switches ATS-2, ATS-3 and ATS-4, located in Electrical Room C122, and ATS-6 through ATS-11, located in Mechanical Room C123, via Modbus RTU
  - 4. Monitoring of four (4) dry contacts on existing ATS-5, located outdoors next to the emergency generator, to indicate source availability (normal and emergency) and source connection (normal and emergency)
  - 5. Monitoring, and remote alarming as required, of an auxiliary dry contact on the 1600A circuit breaker on the emergency generator to indicate when the circuit breaker is tripped or open.
  - 6. Monitoring, and remote alarming as required, of a dry contact on the surge protective device to indicate the status of the SPD for the following three (3) new panelboards:
    - a. Panelboard “GEN” located within the new diesel-engine-driven generator outdoor enclosure.
    - b. Panelboard “1HE1” located in Mechanical Room C123.
    - c. Panelboard “1LE4” located in Mechanical Room C123.
  - 7. Monitoring, and remote alarming as required, of an auxiliary dry contact on the fire pump emergency source circuit breaker, located in Mechanical Room C123, to indicate when the circuit breaker is tripped or open.
  - 8. When the equipment to be monitored provides a Form C auxiliary contact or both a normally open and a normally closed contact, the preferred connection is to the normally closed contact to provide monitoring of the circuit for a disconnected or broken wire.

## 2.3 SOFTWARE AND DRIVERS

- A. Provide new/updated software and/or drivers for operator stations and/or Niagara 4 JACE-8000 control panel as required to implement the scope of work for this project.
- B. Provide new graphical representations in the Niagara 4 BAS of all monitored data described herein including individual graphics, summary screens as well as virtual remote annunciator graphics simulating a traditional, physical remote annunciator.
- C. As a minimum provide the following screens:
  - 1. Overall emergency power system screen showing a graphical representation of the emergency generator, all eleven (11) automatic transfer switches (ATS) and the three (3) panelboard surge protectors.
  - 2. Provide a screen for each individual ATS that displays the monitor data with a virtual remote annunciator including alarms and trends.

3. Provide a screen for the emergency generator that shows all monitored data with a virtual remote annunciator including alarms and trends.
- D. Review all available data points with Designer and Construction Representative before finalizing BAS graphics screen layouts and to determine required BAS alarms, trends, etc.

## **2.4 BAS CONTROLLER**

- A. Niagara 4 JACE-8000 is existing to remain.
- B. Provide I/O expander(s) and RS-485 communication port expanders if/as required to execute the scope of work for this project.

## **2.5 DESKTOP OPERATOR WORKSTATIONS**

- A. Desktop workstations are existing to remain.

## **2.6 SERVERS**

- A. Servers are existing to remain.

## **2.7 SWITCH**

- A. Network switches are existing to remain. If Contractor deems it necessary to add a network switch(es) to execute the Work, the new network switch shall be provided by the Owner. Contractor shall identify the number and location of all necessary network switches and allow 8 weeks for the Owner to furnish the switch(es) as requested.

## **2.8 CONTROL WIRE AND CABLE**

- A. Single conductor control wiring and I/O cable:
  1. Comply with Section 260519 – Low-Voltage Electrical Power Conductors and Cables
  2. Single conductor wire size shall be at least No. 16 AWG.
  3. Non-shielded I/O cable shall be 18 AWG twisted pair, bare copper, non-plenum rated, UL listed.
- B. RS-485 Serial Communication Cable:
  1. Cable shall comply with NFPA 70.
  2. Minimum No. 22 AWG tinned copper, non-plenum rated, low-cap (12.5 pF/ft nominal)

## **2.9 CONTROL WIRING RACEWAYS AND BOXES**

- A. All control wiring and cables shall be installed in a raceway meeting the requirements of Section 260533.13 – Conduit for Electrical Systems.
- B. Comply with requirements in Section 260533.16 – Boxes for Electrical Systems for electrical boxes.

## **2.10 IDENTIFICATION**

- A. Control Equipment and Control Devices:
  - 1. Engraved tag bearing unique identification.
  - 2. Letter size shall be as follows:
    - a. DDC Controllers: Minimum of 0.5 inch high.
    - b. Enclosures: Minimum of 0.5 inch high.
  - 3. Tag shall consist of black lettering on a white background.
  - 4. Tag shall be engraved phenolic consisting of three layers of rigid laminate. Top and bottom layers are color-coded white with contrasting black center exposed by engraving through outer layer.
  - 5. Tag shall be fastened with drive pins.
- B. Raceway and Boxes:
  - 1. Comply with requirements for identification specified in Section 260553 – Identification for Electrical Systems.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Verify new control equipment and devices are suitable for existing control system.
- B. Verify that existing control systems, equipment, devices, etc., which are to remain, are operational.
  - 1. Check calibration and function on existing equipment and devices. Recalibrate as required.
  - 2. Submit calibration and test reports.
- C. Advise Construction Representative and Designer of any issues with existing equipment or controls that are to remain in service.

### **3.2 INSTALLATION**

- A. Comply with equipment/device manufacturers' instructions.
- B. Install software in control units and operator interfaces.
- C. Implement all features of programs to specified requirements and connect and configure equipment and software to achieve proper monitoring, annunciation and alarming.
- D. Install labels and nameplates to identify control components.

### **3.3 ELECTRICAL WIRING AND CONNECTION INSTALLATION**

- A. Bundle and harness multiconductor control cables in place of single cables where several cables follow a common path.

- B. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
- C. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
- D. Install wire and cable with sufficient slack and flexible connectors to allow for vibration of equipment.
- E. All wiring shall be installed in raceway according to Section 260533.13 – Conduit for Electrical Systems.
- F. Raceways: Raceways are to be installed in accordance with the National Electrical Code. Use of liquidtight flexible conduit (LFMC) is limited to 36” to connect from EMT to devices subject to movement. LFMC is not to be used to compensate for misalignment of raceway during installation.

### **3.4 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Test software and hardware for proper operation and prepare test reports.
- C. Remove and replace malfunctioning units and retest.
- D. Verify that wires/cables at control panels are tagged with their service designation and approved tagging system.

### **3.5 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain electrical instrumentation and controls.
- B. Provide a minimum of one (1) hour of instructions to Owner's personnel (4 to 8 people) in the operation and maintenance of the modifications to the control system.
- C. The training shall be scheduled with the Construction Representative to accommodate Owner's schedule but will be performed during normal business hours.
- D. Provide training after the system has been installed and checked out.

**END OF SECTION 260900**



## **SECTION 262413 – SWITCHBOARDS**

### **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 SCOPE**

- A. The Contractor shall furnish and install all switchboards as specified herein and as shown on the Drawings.

#### **1.3 RELATED SECTIONS**

- A. Division 3 – Concrete
- B. Section 260500 – Common Work Results for Electrical
- C. Section 260526 – Grounding and Bonding for Electrical Systems
- D. Section 260529 – Hangers and Supports for Electrical Equipment
- E. Section 260533.13 – Conduit for Electrical Systems
- F. Section 260553 – Identification for Electrical Systems
- G. Section 260573 – Protective Device Coordination Study and Arc Flash Risk Assessment
- H. Section 260583 – Wiring Connections

#### **1.4 SUBMITTALS**

- A. Manufacturer's product data sheets, descriptive bulletins and shop drawings for the switchboard shall be submitted for approval. Shop drawings shall include but not be limited to the following:
  - 1. Specification sheet
  - 2. Master drawing index
  - 3. Front elevation view
  - 4. Floor plan indicating conduit entry/exit locations
  - 5. Top view indicating conduit entry/exit locations
  - 6. Single-line diagram
  - 7. Schematic diagram and wiring (connection) diagram showing wiring from external 120VAC source for circuit breaker shunt trip units
  - 8. Nameplate schedule
  - 9. Component list
  - 10. Assembly ratings including:

- a. Voltage class
    - b. Continuous current rating for horizontal and vertical phase bus, neutral bus and equipment ground bus
    - c. Short circuit current rating
  - 11. Major component ratings including:
    - a. Voltage class
    - b. Continuous current rating
    - c. Interrupting ratings
  - 12. Cable termination lug quantity and sizes
  - 13. Installation information
  - 14. Seismic freestanding equipment certification and equipment anchorage details as specified.
- B. Submittals for Construction/Record:
- 1. Final as-built drawings and information for items listed in Paragraph 1.4 A and B above, that incorporate all changes made during the manufacturing process.
  - 2. Wiring diagrams
  - 3. Certified production test reports
- C. Submit Installation, Operation and Maintenance Manuals at least one (1) week prior to equipment delivery.

## **1.5 REFERENCED STANDARDS**

- A. National Electrical Code (NFPA 70): Article 408 – Switchboards and Panelboards
- B. NEMA PB-2 – Deadfront Distribution Switchboards
- C. UL 489 – Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
- D. UL 891 – Switchboards
- E. UL 1066 – Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures

## **1.6 QUALIFICATIONS**

- A. The manufacturer of the switchboard assembly shall be the manufacturer of the major components within the assembly.
- B. Provide equipment that is IBC/CBC seismically qualified with seismic freestanding label.

## **1.7 FACTORY TESTING**

- A. All switchboards shall be tested in a high-power laboratory to prove adequate mechanical and electrical capabilities.
- B. All factory tests required by the latest ANSI, NEMA and UL Standards shall be performed.

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- C. The manufacturer shall provide certified copies of factory test reports as part of the project record drawings.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- A. The switchboard and all associated components shall have the ratings and arrangement as specified herein and as shown on the Drawings.
- B. The switchboard shall be listed and labeled by Underwriters' Laboratories (UL).
- C. The switchboard shall be a close-coupled assembly to form a single integral, free standing, totally enclosed unit.
- D. The switchboard shall be rated for 480Y/277-volt, 3-phase, 4-wire service as indicated on the Drawings. The continuous current capacity of the switchboard shall be as shown on the Drawings.
- E. The switchboard assembly, including all bus bracing, circuit breakers, and all associated current carrying components shall be designed and constructed to withstand an available fault current of 25,000 RMS symmetrical amperes at 480 VAC. The switchboard assembly shall be FULLY RATED by UL. Series rated devices are not acceptable.
- F. Switchboard continuous current ratings, including all devices, shall be in accordance with the temperature rise specifications set forth by UL, ANSI and NEMA Standards.
- G. A printed nameplate indicating the name of the switchboard manufacturer, the manufacturer's shop order number, the switchboard type or style, system voltage, bus ampacity and short circuit current rating shall be mounted on the outside front surface of the switchboard.
- H. The switchboard shall be wired and tested at the factory and ready for installation when received at the project site.
- I. The switchboard shall be shipped in one or more sections that will pass through a 6-foot wide by 83-inch-high door opening.
- J. Switchboard Warranty: Manufacturer shall warrant equipment to be free from defects in materials and workmanship for a minimum period of one (1) year from date of substantial completion of the project.

### **2.2 CONSTRUCTION**

- A. The switchboard enclosure shall be NEMA Type 1, general-purpose indoor dead-front construction and shall be IBC/CBC Seismic Qualified. Provide a seismic freestanding label on switchboard enclosure.
- B. The switchboard shall be fully self-supporting structures with 30-inch-deep minimum, 36-inch-deep maximum, 90-inch-tall minimum and 91.5-inch-tall maximum, vertical sections, excluding lifting eyes and pull boxes, bolted together to form the required, complete assembly as shown on the Drawings. The overall width of the switchboard assembly shall not exceed 95-inches.

- C. The switchboard frame shall be die formed, 12-gauge steel with reinforced corner gussets. Frame shall be rigidly bolted to support code gauge steel cover plates, bus bars and installed devices during shipment and installation.
- D. The switchboard assembly shall be suitable for rolling or lifting into its final position.
- E. The switchboard assembly, as well as the means of fastening to the concrete floor below the concrete equipment pad, shall be capable of withstanding seismic loads. The International Building Code – 2021 Edition and ASCE 7-16 – Minimum Design Loads for Buildings and Other Structures shall be used as the design code with the specific environmental factors as stated below:
  - 1. Earthquake Design Data:
    - a. Seismic Importance Factor:  $I = 1.5$
    - b. Risk Category: IV
    - c. Mapped Spectral Response Accelerations:  $S_s = 0.446$ ,  $S_1 = 0.160$
    - d. Site Class: D
    - e. Spectral Response Coefficients:  $SDS = 0.429$ ,  $SD1 = 0.243$
    - f. Seismic Design Category: D
    - g. Component Amplification Factor:  $A_p = 2.5$
    - h. Component Response Modification Factor:  $R_p = 2$
    - i. Overstrength Factor:  $\Omega_o = 2$
    - j. Analysis Procedure: Equivalent Lateral Force ASCE 7-16 Section 13.3
- F. All switchboard sections shall be front and rear accessible and front and rear aligned.
- G. The switchboard assembly shall have a solid bottom and individually removable top plate for installation and termination of conduits. All conduit penetrations shall be in the top of the switchboard.
- H. Top conduit areas shall be clearly indicated on the shop drawing submittals.
- I. The sides and rear of the switchboard shall be covered with removable bolt-on covers. All edges of front covers or hinged front panels shall be formed. Provide adequate ventilation within the enclosure.
- J. Provide rodent guards for the enclosure if/as required to prevent entry by mice.
- K. All covers shall be fastened by hex head bolts.
- L. Provide hinged doors over individually mounted device compartments. All doors shall have concealed hinges and be fastened by hex head bolts.
- M. The switchboard shall be UL listed to accept a fixed or group mounted molded case circuit breakers, factory or field installed. Devices shall be front removable and load connections shall be front and rear accessible. Rear enclosure access shall be provided.
- N. All circuit breakers shall be so arranged that the center of the grip of the operating handle, when in its highest position, will not be more than 6'-7" above the floor, in accordance with

Article 404.8(A) of the NEC, when the switchboard is installed on a 3½-inch-high housekeeping pad. In other words, the center of the grip of the operating handle, when in its highest position, shall not be more than 6'-3½" above the bottom of the switchboard.

## **2.3 BUS BAR CONDUCTORS**

- A. The main bus bar conductors shall be horizontally mounted and shall be continuous over the full length of the switchboard. All bussing shall be full size throughout, without reduction.
- B. A 3-phase vertical bus shall be provided in each vertical section for distribution of power from the main horizontal bus. The vertical bus shall be firmly bolted to the horizontal bus for permanent contact.
- C. The vertical bus rating shall be a minimum of 1600 amperes for adequate current carrying capacity and shall extend the full height of each section.
- D. The horizontal and vertical neutral bus shall be of the same ampacity as the phase bus.
- E. All bus bars shall be silver plated copper and shall be made all from the same material. All plating shall be done electrolytically and shall be over the entire length of bus. Plating must be not less than 0.003-inch thick and shall cover both sides and both edges of the bus.
- F. Bus bars shall be mounted on high impact, non-tracking insulated supports. Joints in the vertical bus are not permitted.
- G. Bus bars shall be braced to withstand the mechanical forces exerted during a 65kA RMS symmetrical short circuit condition.
- H. Copper bus bar conductors (phase and ground) shall be fabricated from 1000A/in<sup>2</sup> current density rated Oxygen Free High Conductivity (OFHC) Copper 102, being 99.95 per cent pure copper and having an average annealed conductivity of 101 per cent IACS. Copper bus bar conductors shall be hard-drawn temper and shall meet the requirements of ASTM Specifications B 187.
- I. A horizontal silver-plated copper ground bus shall be provided in the interior throughout the full length of each switchboard. The ground bus shall have a rated ampacity equal to 25% of the main phase bus. The ground bus shall be bonded to the switchboard structure.
- J. Copper bus connections shall be bolted. All bolted connections shall be made using Grade 5 zinc-plated hex-head bolts and Belleville washers. When necessary, the bus shall be split to allow ease in moving and handling. Bus bar splice connectors shall be supplied to join the bus wherever a split has been made. All splice connections shall be made with at least two bolts.
- K. All bus work and connections shall be accessible for inspection and maintenance after first removing the necessary cover plates.
- L. The bus arrangement shall be A-B-C (left to right, top to bottom, front to rear) throughout to assure convenient and safe testing and maintenance.
- M. Insulated horizontal and vertical bus barriers shall be furnished to reduce the hazard of accidental contact with the bus. Vertical bus barriers shall have interlocking front and back

pieces to give added protection on all sides and shall segregate the phases to reduce the possibility of accidental "flash over". Small, separate openings in the vertical bus barriers shall permit unit contacts to pass through and engage the vertical bus bars. Bottom bus covers shall be provided below the vertical bus to protect the ends of the bus from accidental contact with fish tapes or other items entering from the bottom of the enclosure.

- N. The main bus shall have provisions to allow for future extension. All switchboards shall be constructed to allow for the future addition of more sections on either side.
- O. All feeder device line and load connection straps shall be rated to carry current rating of device frame (not trip rating).

## **2.4 WIRING AND TERMINATIONS**

- A. Control wiring, necessary fuse blocks and terminal blocks within the switchboard shall be furnished as required. Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's wiring diagrams.
- B. NEMA 2-hole, long-barrel compression type lugs rated for 75°C rated stranded copper conductors shall be provided for all line side phase and neutral terminations in the incoming line compartment. Lug quantity and size shall be as indicated on the Drawings.
- C. NEMA 2-hole, long-barrel compression type lugs rated for 75°C rated stranded copper conductors shall be provided in the incoming line section for connection of the main equipment grounding conductors.
- D. Compression type lugs in accordance with Section 260583 – Wiring Connections shall be provided for equipment grounding conductor connections to the switchgear ground bus. Additional lugs for connection of feeder circuit grounding conductors shall be provided as indicated on the Drawings.
- E. All control wire shall be minimum 14 AWG, 41-strand copper, 600-volt, type SIS, bundled and secured with nylon ties. Insulated locking spade terminals shall be provided for all control connections, except where saddle type terminals are provided integral to a device. All current transformer secondary leads shall first be connected to conveniently accessible short-circuit terminal blocks before connecting to any other device. All groups of control wires leaving the switchboard shall be provided with terminal blocks with suitable numbering strips. Provide wire markers at each end of all control wiring.

## **2.5 MAIN INCOMING COMPARTMENT**

- A. Location of the main incoming compartment shall be at the top of the switchboard assembly as indicated on the Drawings.
- B. The main incoming compartment shall be sized as required to provide the minimum wire-bending space at the main lug terminals per NEC 312.6 for the quantity and size of the incoming conductors indicated on the Drawings.

## **2.6 FEEDER PROTECTION DEVICES**

- A. All feeder protective devices shall be molded case circuit breakers with inverse time tripping characteristics. Circuit breakers shall be from the same manufacturer as the switchboard assembly.
- B. Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip-free. Automatic tripping of the breaker shall be clearly indicated by the handle position. Contacts shall be non-welding silver alloy and arc extinction shall be accomplished by means of DE-ION arc chutes. A push-to-trip button on the front of the circuit breaker shall provide a local manual means to exercise the trip mechanism.
- C. Circuit breakers shall have a minimum symmetrical interrupting capacity of 25kA RMS symmetrical amperes. Series rated devices are not acceptable.
- D. All molded case circuit breakers shall be equipped with a true RMS sensing, solid-state tripping system consisting of at least three current sensors microprocessor-based trip device and trip actuator. The trip unit shall use microprocessor-based technology to provide the basic adjustable time-current protection.
- E. Provide arc flash energy reduction feature for all circuit breakers 1200A frame and above for compliance with NEC Article 240.87. The use of zone selective interlocking to emulate this feature does not meet the intent of these specifications and will not be allowed.
- F. System coordination shall be provided by adjusting rotary switches for the following microprocessor-based time-current curve shaping adjustments:
  - 1. Adjustable long-delay pick-up setting with minimum of 10 settings
  - 2. Adjustable long-delay time - 0.5 to 24 seconds
  - 3. Adjustable short-delay pick-up setting – 1.5x to Max allowable by frame
  - 4. Adjustable short-delay time 0.0 sec up to 0.5 sec depending on frame with selectable flat or  $I^2t$  curve shaping
  - 5. Adjustable instantaneous setting 2x to Max allowable by frame
  - 6. Adjustable ground fault current pickup ( $0.2 - 1.0 \times I_n$  in 0.10x increments) and time (0.1 – 1.0 sec in 0.10sec increments), with selectable flat or  $I^2t$  curve shaping. Provide switch selectable options for GF OFF, GF alarm, or GF trip. Provide indication of ground fault trip/alarm via the display on the circuit breaker or with amber LED pilot light mounted adjacent to each breaker.
- G. Where indicated on the Drawings, provide 100% continuous current rated UL listed circuit breakers.
- H. Trip units shall be capable of metering phase, neutral, and ground current with an accuracy of +/- 2.0% of the reading and shall have LCD display indicating load current on the circuit breaker and circuit breaker trip settings via menu selections.

## 2.7 ACCESSORIES

- A. Provide shunt trips, bell alarm contacts, auxiliary contacts, pilot lights and control terminal blocks as required to provide the functionality as specified herein and/or as shown on the Drawings.

- B. Provide an adequately sized control power transformer with input disconnect switch and primary and secondary fusing and terminal blocks wired to the shunt trip unit on each circuit breaker to allow tripping each breaker by means of the change in state of a remote dry contact for each feeder.
- C. Provide arc flash energy reduction maintenance switch (ERMS) with blue LED pilot light to allow manual switching to an instantaneous circuit breaker trip setting that is below the arcing fault current as indicated in the Section 260573 – Protective Device Coordination Study and Arc Flash Risk Assessment study report. The ERMS switch/pilot light assembly shall be located immediately adjacent to the circuit breaker that it controls and shall be labeled to clearly indicate its function.
- D. Pilot lights, pushbuttons and selector switches shall be NEMA Type 4/13 watertight/oiltight, round metal, 30.5 mm or 30 mm size. Pilot lights shall be 120VAC, push-to-test, full voltage with high intensity LED type lamps. Lamps shall be replaceable by removal of the color cap. Provide engraved collar type nameplate to indicate function of each device.
- E. Provide DC power supply(ies) and terminal blocks if/as required to power the display on each circuit breaker regardless of the load current flowing through the circuit breaker.
- F. The control power transformer, fuse blocks, terminal blocks, DC power supply(ies) and related components, shall be mounted to a white painted back-pan behind a hinged “control compartment” door.
- G. Provide a remote programming device if required for applying circuit breaker trip settings.

## **2.8 MISCELLANEOUS DEVICES**

- A. Provide a Kirk-Key interlock on the 1600AF/1500AT generator connection cabinet circuit breaker that is keyed the same as the 1600AF/1500AT main line output circuit breaker on the emergency generator as indicated on the Drawings. Coordinate with the Section 263213.13 – Diesel-Engine-Driven Generator Set equipment supplier.

## **2.9 FINISH**

- A. All exterior and interior steel surfaces and bolted joints of the switchboard shall be thoroughly cleaned and prepared for painting and shall have, as a minimum, a baked-on finish consisting of one coat of rust-inhibiting primer and a finish coat, having a minimum dry film thickness of 3 mils of ANSI-61 light gray or ANSI-49 gray enamel.
- B. Furnish one (1) pint or one (1) 12 to 16-ounce spray can of touchup paint.

## **2.10 NAMEPLATES**

- A. Each cubicle door, circuit breaker, and all instruments and control devices shall have laminated plastic nameplates in accordance with Section 260553 – Identification for Electrical Equipment.
- B. The nameplate identifying the switchboard shall have 3/4-inch-high characters. Nameplates identifying switchboard feeder circuit breakers shall have 1/2-inch-high characters. Unless otherwise indicated, all other nameplates shall have 3/16-inch-high characters.



- C. Nameplates shall be engraved as shown on the Drawings or as indicated in these Specifications.

## **2.11 APPROVED MANUFACTURERS**

- A. Switchboards shall be as manufactured by:
  - 1. Eaton, Pow-R-Line Xpert with Type PDG circuit breakers
  - 2. ABB-GE, ReliaGear with Tmax XT circuit breakers
  - 3. Schneider Electric Square D, Series QED with PowerPacT circuit breakers
- B. The basis of design for switchboards is the Eaton, Pow-R-Line Xpert with Type PDG circuit breakers. Should the Contractor choose to provide equipment from one of the other approved manufacturers, he will be responsible for any additional costs resulting from physical changes and/or required accessories to make the equipment work with the existing conditions at the Facility.
- C. All switchboards, panelboards under Specification Section 262416 – Panelboards and enclosed circuit breakers under Section 262816.13 – Enclosed Circuit Breakers shall be provided from the same manufacturer.
- D. Do not order the switchboard until the required short-circuit current ratings have been determined in accordance with Specification Section 260573 – Protective Device Coordination Study and Arc Flash Risk Assessment.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. The Contractor shall verify NEC clearances as indicated on the Drawings prior to installation. Working space and clearances shall be in accordance with NEC Article 110. Verify UL labeling of the assembly prior to installation.
- B. The Contractor shall follow the installation instructions supplied by the manufacturer.
- C. Rig the switchboard assembly into final location and install on level, 3-1/2" high concrete housekeeping pad, with 1" chamfered top edge, per Section 260500 – Common Work Results for Electrical. The pad shall be 2" larger than the switchboard enclosure all around as shown on the Drawings and in accordance with Section 260500 – 2.3 – Equipment Pads and Anchor Bolts.
- D. The switchboard shall be bolted to floor using expansion anchor bolts meeting the requirements of Section 260529 – Hangers and Supports for Electrical Equipment. Anchor bolt size, quantity and placement shall be as indicated in the switchboard manufacturer's installation instructions for seismic freestanding certification. Anchor bolts shall extend through the concrete housekeeping pad to provide the required embedment in the concrete floor below the housekeeping pad.
- E. Secure the top of the switchboard at all four (4) corners to the building structure (column and/or ceiling) with U-channel supports to limit movement during a seismic event.
- F. All conduits shall be terminated in accordance with Section 260533.13 – Conduit for Electrical Systems in the top of the switchboard enclosure and shall have an insulated

throat, grounding type conduit bushing that is bonded to the switchboard equipment ground bus in accordance with Section 260526 – Grounding and Bonding for Electrical Systems.

- G. Grounding conductors shall be terminated on the ground bus using approved compression-type lugs in accordance with Section 260583 – Wiring Connections. The switchgear equipment grounding bus shall be properly connected, by the Contractor, to the nearest approved grounding point with a conductor(s) as indicated on the Drawings.
- H. Provide NEMA Type 12 gasketed hole seals for all unused conduit openings in the top of all switchboard enclosures.
- I. Perform insulation tests on each phase and verify low-resistance ground connection on ground bus.
- J. Torque all bolted connections made in the field in accordance with manufacturer's published values using calibrated torque wrench and verify all factory bolted connections.

### **3.2 ARC FLASH HAZARD WARNING LABELS**

- A. Provide an arc flash hazard warning label on the front exterior of the switchboard in accordance with Sections 260553 - Identification for Electrical Systems and 260573 – Protective Device Coordination Study and Arc Flash Risk Assessment.

### **3.3 START-UP AND COMMISSIONING**

- A. The Contractor shall provide the services of a factory authorized service representative to:
  - 1. Inspect the completed installation.
  - 2. Apply electronic trip unit settings in accordance with the protective device settings table in the protective device coordination study provided under Section 260573 – Protective Device Coordination Study and Arc Flash Risk Assessment.
  - 3. Place the system in regular, satisfactory operation.
  - 4. Instruct the Owner's maintenance staff in the operation and maintenance of the equipment.

**END OF SECTION 262413**

## **SECTION 262416 – PANELBOARDS**

### **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 SCOPE**

- A. The Contractor shall furnish and install all circuit breaker panelboards as specified herein and as shown on the Drawings.

#### **1.3 RELATED SECTIONS**

- A. Section 260500 – Common Work Results for Electrical
- B. Section 260526 – Grounding and Bonding for Electrical Systems
- C. Section 260529 – Hangers and Supports for Electrical Equipment
- D. Section 260533.13 – Conduit for Electrical Systems
- E. Section 260553 – Identification for Electrical Systems
- F. Section 260573 – Protective Device Coordination Study and Arc Flash Risk Assessment
- G. Section 260583 – Wiring Connections
- H. Section 260900 – Instrumentation and Control for Electrical Systems

#### **1.4 SUBMITTALS**

- A. Manufacturer's product data sheet and shop drawing shall be submitted for each circuit breaker panelboard, including the circuit breakers and surge protective device (SPD).
- B. Panelboard shop drawings shall include, but not be limited to, the following:
  - 1. Outline drawings including the overall panelboard enclosure dimensions, interior mounting dimensions and wiring gutter dimensions.
  - 2. The location of the circuit breakers, neutral and equipment ground buses and SPD.
  - 3. Type and ratings of all circuit breakers.
- C. Seismic equipment certification and equipment anchorage details for all panelboards.
- D. The following submittals shall be provided for each panelboard surge protective device (SPD):
  - 1. Provide verification that the SPD unit complies with the required UL 1449, Fourth Edition and UL 1283 surge voltage rating (SVR).

2. Provide actual let through voltage test data in the form of oscillograph results for both the ANSI/IEEE C62.41 Category C3 (combination wave) and B3 (ringwave) tested in accordance with ANSI/IEEE C62.45.
3. Provide test report from a nationally recognized independent testing laboratory verifying the SPD components can survive published surge current rating on both a per mode and per phase basis using the IEEE C62.41, 8 x 20 microsecond current wave. Test data on individual module is not acceptable.
4. Provide spectrum analysis of each unit based on MIL-STD-220A test procedures between 50 kHz and 200 kHz verifying the device's noise attenuation exceeds 44 dB at 100 kHz.
5. Provide test report from a nationally recognized independent testing laboratory verifying the SPD overcurrent protection will allow the rated maximum surge current to pass through the device without fuse operation.
6. Provide life cycle testing certification.
7. Provide an equipment manual that includes but is not limited to spare parts lists and operating instructions for the specified SPD unit.
8. SPD warranty certificate

## **1.5 REFERENCED STANDARDS**

- A. IEEE C62.41.1, IEEE Guide on the Surge Environment in Low-Voltage (1000 V and Less) AC Power Circuits
- B. IEEE C62.41.2, IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits
- C. IEEE C62.45, IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits
- D. National Electrical Code: Article 242
- E. National Electrical Code: Article 408
- F. UL 67 – Panelboards
- G. UL 489 – Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
- H. UL 1283 – Electromagnetic Interference Filters
- I. UL 1449, 4th Edition – Surge Protective Devices

## **1.6 QUALIFICATIONS**

- A. The manufacturer of the panelboard assemblies shall be the manufacturer of the major components within each assembly.
- B. Provide equipment that is IBC/CBC seismically qualified with seismic certification label.

## **1.7 LISTING REQUIREMENTS**

- A. Panelboards shall bear the UL Mark and shall be listed to the most recent edition of UL 67.
- B. SPD shall bear the UL Mark and shall be listed to the most recent editions of UL 1449 and UL 1283. "Manufactured in accordance with" is not equivalent to UL listing and does not meet the intent of this specification.
- C. Provide an IBC/CBC seismic certification label on each panelboard enclosure.

## **1.8 QUALITY ASSURANCE**

- A. All panelboards shall be tested at the factory for compliance with all applicable codes and standards and shall be ready for installation when received at the project site.

## **PART 2 - PRODUCTS**

### **2.1 CIRCUIT BREAKER PANELBOARDS**

- A. Circuit breaker panelboards must be of panelboard type construction. Load centers are not acceptable.
- B. Circuit breaker panelboards shall be dead front safety type equipped with circuit breakers. Each panelboard, including all bus bracing, shall have an integrated short circuit withstand rating equal to the short circuit interrupting capacity of the circuit breakers. All panelboards shall be fully rated. Series rated panelboards are not acceptable. Panelboard bus structure and main lugs or main breaker shall have current and voltage ratings, number of phases, poles and number of wires and short circuit current rating as indicated on the Drawings.
- C. Panelboard enclosures shall be fabricated from code gauge galvanized steel constructed in accordance with UL 50 requirements.
- D. All panelboard enclosures shall be surface mounted, fabricated from cold-rolled galvanized steel. Each panelboard shall have an outer door and an inner door both equipped with a locking handle requiring a milled key. The doors and frame shall be coated on all sides with rust-inhibiting primer and finished with the appropriate number of coats of ANSI-61 or ANSI-49 gray baked-on enamel paint. At least one key shall be provided with each panelboard, and all panelboard locks shall be keyed alike. The inner door shall provide access to only the circuit breakers, while the outer door shall be secured to the edge of the enclosure with a continuous hinge from top to bottom to provide access to the panelboard wiring gutters. All panelboard enclosures shall be NEMA Type 1, door-in-door or door-hinged-to-box.
- E. The panelboard assembly, as well as the means of fastening to the concrete floor below the concrete equipment pad and/or the wall, shall be capable of withstanding seismic loads. The International Building Code – 2021 Edition and ASCE 7-16 – Minimum Design Loads for Buildings and Other Structures shall be used as the design code with the specific environmental factors as stated below:
  - 1. Earthquake Design Data:
    - a. Seismic Importance Factor:  $I = 1.5$
    - b. Risk Category: IV
    - c. Mapped Spectral Response Accelerations:  $S_s = 0.446$ ,  $S_1 = 0.160$

- d. Site Class: D
  - e. Spectral Response Coefficients:  $SDS = 0.429$ ,  $SD1 = 0.243$
  - f. Seismic Design Category: D
  - g. Component Amplification Factor:  $A_p = 2.5$
  - h. Component Response Modification Factor:  $R_p = 2$
  - i. Overstrength Factor:  $\Omega_o = 2$
  - j. Analysis Procedure: Equivalent Lateral Force ASCE 7-16 Section 13.3
- F. A framed directory card with a clear plastic covering shall be provided on the inside of the inner door. The directory card shall be in accordance with Section 260553 – Identification for Electrical Systems.
- G. All panelboard interiors shall be equipped with bus bars and adjustable means for positioning the interior within the enclosure to ensure the dead front fits snugly over the circuit breakers.
- H. All bus bars shall be silver-plated copper and shall be made all from the same material. All plating shall be done electrolytically and shall cover the entire length of bus. Plating must be not less than 0.003-inch thick and shall cover both sides and all edges of each bus bar. Aluminum bus bars will not be acceptable.
- I. All bus bar conductors (phase, neutral, and ground) shall be fabricated from Oxygen Free High Conductivity (OFHC) Copper 102, being 99.95 per cent pure copper and having an average annealed conductivity of 101 per cent IACS. Copper bus bar conductors shall be hard-drawn temper, shall meet the requirements of ASTM Specifications B 187, and shall be sized in accordance with Underwriters' Laboratories Standards. Neutral bus bar conductors shall be insulated from the panelboard and shall be the same size as the phase bus bar conductors.
- J. Bus bars shall extend the full height of the available space for mounting future circuit breakers.
- K. The panelboard interior shall be provided with a copper ground bus bar conductor(s) equal to at least 25% ampacity of the phase bus bar conductors, which shall be bonded to the panelboard enclosure.
- L. The neutral bus bar conductor and the ground bus bar conductor shall each be provided with an individual terminal or lug for each wire connected to it.
- M. The neutral bus bar and the ground bus bar shall not be electrically bonded together.
- N. The location of the main terminations, top or bottom, shall be determined by the entrance of the incoming power feeder conductors to the panelboard enclosure.
- O. Provide molded case, thermal magnetic main circuit breaker or UL listed main lugs in each panelboard as indicated on the Drawings. All lugs shall be rated for a minimum temperature of 75°C and sized to allow terminating the quantity and size of stranded copper conductors indicated on the Drawings.
- P. Circuit breakers shall be quick-make, quick-break, bolt-on type having over center toggle mechanisms with thermal magnetic trips and shall be trip free. All circuit breakers shall be by the same manufacturer as the panelboards. Multi-pole circuit breakers shall have common trips and a single operating handle. Handle tie bars will not be accepted.

- Q. Circuit breakers shall be provided with a means for indicating a tripped position. Circuit breaker voltage, ampere rating and number of poles shall be as indicated on the Drawings. Circuit breakers shall be equipped with individually insulated, braced, and protected connectors.
- R. Circuit breakers shall have a minimum short-circuit interrupting capacity as indicated on the Drawings.
- S. Circuit breakers shall include factory installed mechanical lugs that are UL listed to accept stranded copper conductors. Lugs shall be aluminum or copper. Steel or galvanized steel lugs are not acceptable. Circuit breaker lugs shall be UL listed and rated for a minimum temperature of 75°C.
- T. All circuit breaker panelboards shall have a minimum of 25% “extra” space for future circuit breakers.
- U. Provide spare circuit breakers as indicated on the Drawings.
- V. Single-pole circuit breakers having 15 or 20 ampere ratings shall be UL Listed as Switching Duty (SWD) rated.
- W. Circuit breakers protecting circuits supplying heating, ventilation or air conditioning equipment shall be UL Listed as HACR type.
- X. All wiring terminals for conductors leaving the panel shall be designed to be used with copper conductors.
- Y. Bussing sequence shall be distributed phase sequence type. Bus sequence shall start at the top left phase bus of the interior for both top and bottom fed panels. Sequencing shall be A-B-C, left to right, top to bottom, front to back as viewed from the front of the panelboard.
- Z. Provisions or spaces for future circuit breakers shall be located at the bottom of the panel for top feed main or at the top of the panel for bottom feed main. All open, blank circuit breaker knockouts shall be properly plugged with suitable manufacturer provided blanking devices.
- AA. Locate next to each breaker, space, or provision an individual number permanently affixed to the panelboard. Numbering tape or painted numbers shall not be acceptable.
- BB. Integral Surge Protective Device (SPD) on the life safety branch of the emergency power system per NEC 700.8:
  - 1. Provide SPD in each panelboard.
  - 2. SPD shall be UL 1449 labeled with a 200kA Short Circuit Current Rating (SCCR). Fuse ratings shall not be considered in lieu of demonstrated withstand testing of SPD.
  - 3. SPD shall be UL 1449 labeled as Type 2, installed on the load side of the main service disconnect device. Every suppression component of every mode, including N-G, shall be protected by internal overcurrent and thermal overtemperature controls. An SPD relying upon external or supplementary installed safety disconnects does not meet the intent of this specification.
  - 4. SPD shall be UL 1449 labeled with 20kA I-nominal (In).
  - 5. Suppression components shall be heavy duty, thermally protected, 50kA MOVs.

6. SPD shall provide surge current paths for all modes of protection: L-N, L-G, N-G, and L-L for grounded wye systems.
7. SPD shall be integral to the panelboard and shall be directly mounted to the panelboard bus bars.
8. SPD shall meet or exceed the following criteria:
  - a. Surge Current Capacity Rating shall be:
    - 1) 480Y/277V, 3-phase, 4-wire panelboards: 80kA per mode and 160kA per phase
    - 2) 208Y/120V, 3-phase, 4-wire,  $\geq 150$ A bus panelboards: 60kA per mode and 120kA per phase
    - 3) 208Y/120V, 3-phase, 4-wire,  $< 150$ A bus panelboards: 50kA per mode and 100kA per phase
  - b. UL 1449 Listed Voltage Protection Ratings (VPRs) shall not exceed the following:
 

| <u>Nominal Voltage</u> | <u>L-N</u> | <u>L-G</u> | <u>N-G</u> | <u>L-L</u> |
|------------------------|------------|------------|------------|------------|
| 208Y/120V, 60 Hz       | 700V       | 700V       | 600V       | 1000V      |
| 480Y/277V, 60 Hz       | 1000V      | 1200V      | 1000V      | 1800V      |
  - c. UL 1449 Listed Maximum Continuous Operating Voltage (MCOV):
 

| <u>Nominal Voltage</u> | <u>L-N</u> | <u>L-G</u> | <u>N-G</u> | <u>L-L</u> |
|------------------------|------------|------------|------------|------------|
| 208Y/120V, 60 Hz       | 150V       | 150V       | 150V       | 300V       |
| 480Y/277V, 60 Hz       | 320V       | 320V       | 320V       | 640V       |
9. SPD shall have UL 1283 EMI/RFI filtering with active tracking up to 50dB from 10kHz to 100MHz.
10. SPD shall be equipped with the following diagnostics:
  - a. Visual LED diagnostics including a minimum of one green LED indicator per phase, and one red service LED
  - b. Audible alarm with on/off silence function and diagnostic test function
  - c. Surge Counter
  - d. Form C dry status contact rated 150VDC or 125VAC, 1A maximum
  - e. No other test equipment shall be required for SPD monitoring or testing before or after installation.
11. Environmental Conditions:
  - a. Operating temperature: -4°F to 122°F
  - b. Relative humidity: 5 – 95%, non-condensing
12. SPD Warranty: SPD shall have a full ten (10) year manufacturer's warranty from date of initial service, incorporating unlimited replacements of suppressor parts if they are destroyed by transients during the warranty period.

CC. The inside of the panel or door shall have a printed nameplate indicating the name of the panelboard manufacturer, the manufacturer's shop order number, panelboard type, system voltage and bus bar ampacity. Paper type labels are not acceptable. Each panelboard shall be marked with its UL short circuit current rating.



- DD. All panelboards shall be built in accordance with and to meet the requirements of the applicable sections of the National Electrical Code, NEMA Publication PBI and OSHA. All panelboards shall bear the Underwriters' Laboratories (UL) label of approval.
- EE. 480V, 3-phase, 3-wire rated circuit breaker panelboards shall be:
  - 1. Eaton Type PRL3X with Type PDG bolt-on branch circuit breakers
  - 2. ABB-GE ReliaGear RD with Type FBVTE bolt-on branch circuit breakers
  - 3. Square D Type NF with Type EGB bolt-on branch circuit breakers
- FF. 480Y/277V, 3-phase, 4-wire rated circuit breaker panelboards shall be:
  - 1. Eaton Type PRL2X with Type GHB and GHQ bolt-on branch circuit breakers
  - 2. ABB-GE ReliaGear RE with Type TEY bolt-on branch circuit breakers
  - 3. Square D Type NF with Type EDB bolt-on branch circuit breakers
- GG. 208Y/120V rated circuit breaker panelboards shall be:
  - 1. Eaton Type PRL1X with Type BAB bolt-on branch circuit breakers
  - 2. ABB ReliaGear RQ with Type THQB bolt-on branch circuit breakers
  - 3. Square D Type NQ with Type QOB bolt-on branch circuit breakers
- HH. The basis of design for all panelboards is Eaton Type PRL\_X. Should the Contractor choose to provide equipment from one of the other approved manufacturers, he will be responsible for any additional costs resulting from physical changes and/or required accessories to make the equipment work with the existing conditions at the Facility.
- II. All panelboards, switchboards under Specification Section 262413 – Switchboards and enclosed circuit breakers under Section 262816.13 – Enclosed Circuit Breakers shall be provided from the same manufacturer.
- JJ. Do not order circuit breaker panelboards until the required short-circuit current ratings have been determined in accordance with Specification Section 260573 – Protective Device Coordination Study and Arc Flash Risk Assessment.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install at locations indicated on the Drawings. All mounting and supporting materials shall be provided as indicated on the Drawings and in accordance with Section 260529 - Hangers and Supports for Electrical Equipment.
- B. Install panelboards in accordance with the manufacturers written instructions.
- C. Locate and arrange with proper clearances from other equipment and material to obtain good accessibility for operation and maintenance. Working space and clearances shall be in accordance with NEC Article 110.
- D. Clean all welds, scars, and abrasions; remove metal splatter, rust, and all foreign materials; and apply an organic zinc-rich coating of the following manufacture:
  - 1. Carboline SP676

2. Cook 920-A-171
  3. Koopers' Organic Zinc
- E. For panelboards  $\leq 5'-8''$  high, install so that the top of the panelboard is 6'-0" above the floor.
- F. Panelboards over 5'-8'' high shall be mounted on a 3-1/2" high concrete housekeeping pad per Section 260500 – Common Work Results for Electrical with 1" chamfered top edge that is 2" larger than the panelboard enclosure in the front and on both sides. The panelboard shall be bolted to the floor using expansion anchor bolts meeting the requirements of Section 260529 – Hangers and Supports for Electrical Equipment.
- G. Anchor bolt size, quantity and placement shall be as indicated in the panelboard manufacturer's installation instructions for seismic certification. For floor mounted panelboards, anchor bolts shall extend through the concrete housekeeping pad to provide the required embedment in the concrete floor below the housekeeping pad. As a minimum, provide one anchor bolt at each corner with 6" minimum embedment into the concrete floor below the housekeeping pad.
- H. All panelboards shall be mounted in such a way as for the center of the grip of the operating handle of the topmost circuit breaker(s) in the panelboard, when in the highest position, are not more than 6'-7" above the floor or working platform, including the height of the housekeeping pad if one is installed, for compliance with NEC 404.8(A).
- I. Adjust the interior such that the dead front fits securely over all the circuit breakers and there are no gaps or spaces.
- J. Provide blank filler plates for all unused circuit breaker spaces in all panelboards.
- K. Provide NEMA Type 12 gasketed hole seals for all unused conduit openings in the top or sides of all panelboard enclosures. Unused conduit openings in the bottom of NEMA Type 1 panelboard enclosures can be sealed with NEMA Type 1 rated hole seals.
- L. Visual and Mechanical Inspection: Inspect all panelboards for physical damage, proper alignment, anchorage, and grounding. Check installation and tightness of connections at main lugs and at all circuit breakers in accordance with manufacturer's published torque values.
- M. Perform insulation tests on each phase and verify low-resistance ground connections on equipment ground bus.
- N. Reset SPD surge counter in each panelboard to zero (0).

### **3.2 IDENTIFICATION**

- A. Each panelboard shall have a laminated plastic nameplate on the outside surface of the door engraved with the panelboard designation as indicated on the Drawings in accordance with Section 260553 – Identification for Electrical Systems.

### **3.3 PANELBOARD CIRCUIT DIRECTORIES**

- A. Each panelboard shall have a typewritten, framed circuit directory card with a clear plastic covering mounted on the inside of the door identifying the load(s) served by each circuit breaker in accordance with Section 260553 – Identification for Electrical Systems.

### **3.4      ARC FLASH HAZARD WARNING LABEL**

- A.    Provide arc flash hazard warning label on exterior door of all panelboards in accordance with Sections 260553 - Identification for Electrical Systems and 260573 – Protective Device Coordination Study and Arc Flash Risk Assessment.

**END OF SECTION 262416**

## **SECTION 262726 – WIRING DEVICES**

### **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 SCOPE**

- A. The Contractor shall furnish and install all receptacle cover plates as specified herein and as shown on the Drawings.

#### **1.3 RELATED SECTIONS**

- A. Section 260500 – Common Work Results for Electrical
- B. Section 260533.16 – Boxes for Electrical Systems
- C. Section 260553 – Identification for Electrical Systems
- D. Section 260583 – Wiring Connections

#### **1.4 SUBMITTALS**

- A. Manufacturer's product data sheets shall be submitted for each of the following:
  - 1. Toggle switches
  - 2. Receptacles
  - 3. Ground fault circuit interrupter receptacles
  - 4. Wiring device cover plates
  - 5. While-in-use weatherproof covers for duplex GFCI receptacle

### **PART 2 - PRODUCTS**

#### **2.1 TOGGLE SWITCHES**

- A. General purpose toggle switches for indoor use in dry, non-hazardous locations shall be Specification Grade, toggle type, rated for 20 amperes, 120/277 volts AC, 60 hertz, having binding terminal screws for back and side wiring to accept up to Size 10 AWG copper wire, totally enclosed molded base and cover, quiet operation, and brown switch handles. Toggle switches shall have approved self-grounding straps and/or a grounding terminal having a green hex head screw. Final device color choice will be selected by Construction Representative as part of the shop drawing submittal process from all available colors offered.
- B. Toggle switches shall have approved self-grounding straps and/or a grounding terminal having a green hex head screw.
- C. General purpose toggle switches for indoor use shall be rated for a minimum of 1 HP at 120 VAC.

- D. General purpose toggle switches shall meet Federal Specification W-S-896 and shall be UL listed and labeled.
- E. Switches identified on the Drawings with the symbol "S" shall be single-pole, single-throw, two-position maintained contact switches and shall be Hubbell HBL1221, Arrow-Hart 1991 or Leviton 1221-2.
- F. Switches identified on the Drawings with the symbol "S<sub>3</sub>" shall be single-pole, double-throw, "three-way", two-position maintained contact switches and shall be Hubbell HBL1223, Arrow-Hart 1993 or Leviton 1223-2.

## **2.2 RECEPTACLES**

- A. General purpose receptacles for indoor use in non-hazardous locations shall be extra heavy-duty industrial grade, having binding terminal screws for back and side wiring with copper conductors, brown nylon face with molded phenolic base, green hex grounding screw terminal and brass receptacle strap assembly approved for grounding. Final device color choice will be selected by Construction Representative as part of the shop drawing submittal process from all available colors offered.
- B. General purpose receptacles shall be duplex, 20 amperes, 125 volts AC-DC, 2-pole, 3-wire grounding, straight blade, NEMA 5-20R configuration; Hubbell HBL5362, Arrow-Hart 5362, or Leviton 5362A
- C. Receptacles identified on the Drawings with the symbol "GFCI" shall be extra heavy duty industrial grade, tamper resistant, weather resistant, corrosion resistant, self-testing ground fault circuit interrupter, having nickel plated brass power and ground contacts with binding terminal screws for back and side wiring with solid or stranded copper conductors up to size 10 AWG, yellow nylon face with high impact polyester housing, device mounted "TEST" and "RESET" push buttons, solid green power indicator, solid red GF/Trip indicator, flashing red end-of-life indication, and with differential current sensing device capable of detecting ground fault currents of 5 milliamps, plus or minus 1 milliamp with conformal coated printed circuit board, and interrupt supply circuit within the UL trip time curve. Mounting strap assembly shall be nickel plated brass, approved for grounding, with stainless steel mounting screws and stainless-steel auto self-grounding clip. Maximum continuous operating temperature shall be  $\geq 66^{\circ}\text{C}$ . Dielectric withstand voltage shall be  $\geq 1.5\text{kV}$ . Short circuit current rating shall be  $\geq 10\text{kA}$ .
- D. GFCI receptacles shall be duplex, 20 amperes, 125 volts AC, 2-pole, 3-wire grounding, straight blade, NEMA 5-20R configuration meeting UL 498, UL 943, NEMA WD-6 and complying with all National Electrical Code (NEC) requirements for GFCI receptacles, TR and WR resistance, UL E41978 Federal Spec listed and labeled; Hubbell GF5362SGYEL or approved equal by Arrow-Hart or Leviton
- E. All receptacles shall meet Federal Specification W-C-596 and shall be UL listed and labeled.

## **2.3 WIRING DEVICE COVER PLATES**

- A. Cover plates for all indoor toggle switches and receptacles in unfinished spaces shall be manufacturer's standard size Type 302 stainless steel, satin finish, anti-magnetic having a thickness of 0.032 inches and containing 18% chromium and 8% nickel. Jumbo sized cover plates shall not be used.

- B. Cover plates shall be provided from the same manufacturer as the wiring devices.
- C. All wiring device cover plates shall meet NEMA and ANSI Standards and UL File E91963 – Guide QCDX and Federal Specification WP-455A

## **2.4 WHILE-IN-USE WEATHERPROOF COVERS FOR DUPLEX GFCI RECEPTACLE**

- A. Weatherproof covers for duplex GFCI type receptacle located outdoors shall be UL Listed for wet location (raintight) use with utilization equipment attachment plug inserted into the receptacle.
- B. Cover door shall be spring loaded, self-closing type and the cover shall be designed for installation on a vertically mounted Type FD box housing a duplex GFCI receptacle.
- C. Cover shall be provided with weatherproof gasket and shall have one stainless steel attachment screw in each corner.
- D. Cover shall be cast aluminum with powder coated gray finish.
- E. Cover shall be NEMA 3R rated and shall meet or exceed the extra duty rating of UL 514D and shall comply with NEC 406.9(B).
- F. While-in-use weatherproof covers for duplex GFCI receptacle shall be Hubbell WP26E or approved equal by Appleton Electric, Eaton Crouse-Hinds, Killark, or O-Z/Gedney.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Single-pole toggle switches shall be installed so that the switch is "ON" when the toggle handle is in the UP position.
- B. Receptacles shall be mounted vertically so that the U-shaped grounding slot is at the TOP.
- C. The white neutral conductor shall always be connected to the "white" wire or "silver" colored terminal (large slot) of the receptacle.
- D. The grounding yoke of all switches and receptacles shall be firmly connected to the device box.
- E. Do not feed through outlets. Provide wiring pigtails on all receptacles.
- F. Mounting heights for all general-purpose switches and receptacles shall be as indicated in Section 260500 – Common Work Results for Electrical.

### **3.2 CIRCUIT IDENTIFICATION**

- A. Cover plates for all general-purpose switches and receptacles shall be marked on the outside surface of the cover plate with a printer generated peel and stick label in accordance with Section 260553 – Identification for Electrical Systems with the source panelboard designation and circuit number.

### **3.3 TESTING**

- A. All general-purpose toggle switches and dimmer controls shall be tested for proper wiring and operation.
- B. All receptacles shall be tested for correct wiring and polarity.
- C. All GFCI receptacles shall be tested for proper ground fault protection operation.
- D. Malfunctioning Devices: Repair or replace and retest. Repeat procedure until all units operate properly.

**END OF SECTION 262726**

## **SECTION 262813 – FUSES**

### **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 SCOPE**

- A. The Contractor shall furnish and install all fuses as specified herein and as shown on the Drawings.

#### **1.3 RELATED SECTIONS**

- A. Section 260500 – Common Work Results for Electrical
- B. Section 260573 – Protective Device Coordination Study and Arc Flash Risk Assessment

#### **1.4 SUBMITTALS**

- A. Manufacturer's product data sheets shall be submitted for the following items:
  - 1. Each type of fuse

#### **1.5 EXTRA MATERIALS**

- A. The Contractor shall provide and turn over to the Owner 10% spare fuses (minimum of 3) for each size and type of fuse used on this project, including control fuses.

### **PART 2 - PRODUCTS**

#### **2.1 250-VOLT AND 600-VOLT FUSES**

- A. Fuses and their applications shall meet all the requirements of NEMA, the National Electrical Code (NFPA 70) and OSHA Part 1910 Subpart S. Fuse sizes and types shall be as shown on the Drawings and in schedules. Fuses shall be properly coordinated and shall be verified by the Contractor for the final load served. All fuses shall be Underwriters' Laboratories (UL) approved and shall have standard NEC dimensions.
- B. Fuses used on circuits up to 250 volts shall be 250V, dual element, time delay, current limiting and shall have a minimum short circuit interrupting capacity of 300,000 RMS symmetrical amperes, UL Class RK1, 250V for sizes up to 600 amperes.
- C. Fuses used on circuits above 250 volts up to 600 volts shall be 600V, dual element, time delay, current limiting and shall have a minimum short circuit interrupting capacity of 300,000 RMS symmetrical amperes, UL Class RK1 or Class J (as indicated on the Drawings) for sizes up to 600 amperes.
- D. Fuses shall be as manufactured by the Eaton Bussmann or approved equal by Mersen or Littlefuse.



- E. Control circuit fuses (less than 5 amps) and associated fuse holders shall be as shown on the Drawings.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Equipment shall not be shipped and/or delivered to the job site with the fuses installed in place.
- B. Install fuses in fuse clips with fuse label facing out such that it is visible for inspection without removing the fuse from the fuse clips.

**END OF SECTION 262813**

## **SECTION 262816.13 – ENCLOSED CIRCUIT BREAKERS**

### **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 SCOPE**

- A. The Contractor shall furnish and install all enclosed circuit breakers as specified herein and as shown on the Drawings.

#### **1.3 RELATED SECTIONS**

- A. Section 260500 – Common Work Results for Electrical
- B. Section 260526 – Grounding and Bonding for Electrical Systems
- C. Section 260529 – Hangers and Supports for Electrical Equipment
- D. Section 260553 – Identification for Electrical Systems
- E. Section 260573 – Protective Device Coordination Study and Arc Flash Risk Assessment
- F. Section 260583 – Wiring Connections

#### **1.4 SUBMITTALS**

- A. Manufacturer's product data sheets shall be submitted for each type and size of enclosed circuit breaker used on this project, including information on the electronic trip unit.
- B. Provide dimensioned outline drawing for circuit breaker enclosures.

#### **1.5 REFERENCED STANDARDS**

- A. National Electrical Code: Articles 230, 240, 312, and 404
- B. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations
- C. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures

#### **1.6 LISTING REQUIREMENTS**

- A. Enclosed circuit breakers shall be UL 489 Listed and Labeled.

## **PART 2 - PRODUCTS**

### **2.1 ENCLOSED CIRCUIT BREAKER FOR EMERGENCY GENERATOR FEED TO FIRE PUMP AUTOMATIC TRANSFER SWITCH**

- A. Provide an enclosed molded case circuit breaker as indicated on the Drawings for the emergency source connection to the fire pump automatic transfer switch (FPATS).
- B. The circuit breaker shall have the following ratings:
  - 1. Type: Molded case thermal magnetic
  - 2. Frame size: 250A
  - 3. Rating plug: 100A
  - 4. Continuous current rating: 80%
  - 5. Electronic trip unit: Long time, short time and instantaneous trip settings and ground fault alarm.
  - 6. Short circuit rating: 25kA
- C. The circuit breaker shall comply with all applicable requirements of NFPA 20 and Article 695 of the National Electrical Code (NFPA 70).
- D. Provide the circuit breaker with two (2) 52a/52b auxiliary contacts to indicate when the circuit breaker is tripped or open.
- E. Terminal lugs on the line and load side of the circuit breaker shall be sized for one (1) #4 AWG to 250 kcmil conductor, shall be Underwriters' Laboratories (UL) listed as being suitable for copper or aluminum conductors and shall be equipped with solderless connectors, front removable. All current carrying parts shall be plated by electrolytic processes to resist corrosion and to promote cool operation.
- F. Provide equipment ground bus within the circuit breaker enclosure, bonded to the enclosure, with lugs for connection of two (2) #8 AWG to #4 AWG copper equipment grounding conductors.
- G. Circuit breaker enclosure shall be NEMA Type 12 without knockouts and shall have a hinged cover.
- H. All enclosures shall be prime coated with a rust-inhibiting phosphate and finished in ANSI-61 light gray or ANSI-49 gray baked-on enamel paint.
- I. Circuit breaker enclosures shall be sized as required to provide enough air space around the circuit breaker for proper cooling in an ambient temperature of up to 95°F.
- J. The circuit breaker operating handle shall physically indicate the ON and OFF positions of the breaker. The operating handle shall be able to accept a minimum of two padlocks for padlocking the handle in the OFF position and shall have the capability of accepting at least one padlock for padlocking the handle in the ON position. Padlocking provisions for the handle shall be based on using padlocks having heavy duty industrial type shackles 3/8-inch thick.
- K. The enclosure door shall be mechanically interlocked with the circuit breaker operating handle to prevent opening the door when the circuit breaker is in the ON position.

- L. Enclosed circuit breaker approved manufacturers are:
  - 1. ABB
  - 2. Eaton
  - 3. Square D Company
- M. All enclosed circuit breakers, switchboards under Section 262413 – Switchboards and panelboards under Specification Section 262416 – Panelboards shall be provided from the same manufacturer.
- N. Do not order any enclosed circuit breakers until the required short-circuit current ratings have been determined in accordance with Specification Section 260573 – Protective Device Coordination Study and Arc Flash Risk Assessment.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Provide a separately enclosed circuit breaker for the emergency generator feeder to the fire pump automatic transfer switch as indicated on the Drawings.
- B. Apply electronic trip unit settings in accordance with the protective device settings table in the protective device coordination study provided under Section 260573 – Protective Device Coordination Study and Arc Flash Risk Assessment.

### **3.2 IDENTIFICATION**

- A. Provide a three-layer engraved laminated plastic nameplate meeting the requirements of Section 260553 – Identification for Electrical Systems with 1” high white characters on a red background:

FIRE PUMP  
DISCONNECTING MEANS

- B. Install nameplate on the outside surface of the circuit breaker enclosure door.

### **3.3 ARC FLASH HAZARD WARNING LABEL**

- A. Provide arc flash hazard warning label on circuit breaker enclosure door in accordance with Sections 260553 - Identification for Electrical Systems and 260573 – Protective Device Coordination Study and Arc Flash Risk Assessment.

## **END OF SECTION 262816.13**

## **SECTION 262912 – MOTOR CONTROL**

### **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 SCOPE**

- A. The Contractor shall furnish and install all motor controls as specified herein and as shown on the Drawings.

#### **1.3 RELATED SECTIONS**

- A. Section 260500 – Common Work Results for Electrical
- B. Section 260519 – Low-Voltage Electrical Power Conductors and Cable
- C. Section 260526 – Grounding and Bonding for Electrical Systems
- D. Section 260529 – Hangers and Supports for Electrical Equipment
- E. Section 260533.13 – Conduit for Electrical Systems
- F. Section 260553 – Identification for Electrical Systems
- G. Section 260583 – Wiring Connections

#### **1.4 DEFINITIONS**

- A. Where the term “motor starter” is used on the Drawings or in these specifications it shall be understood to have the same meaning as the term “motor controller” and the term “full-voltage across-the-line motor starter” shall have the same meaning as the term “across-the-line motor controller” as indicated herein.

#### **1.5 SUBMITTALS**

- A. Manufacturer's product data sheets shall be submitted for each type of motor control device.

### **PART 2 - PRODUCTS**

#### **2.1 GENERAL**

- A. All control voltages shall be 120 volts AC, 60 hertz, unless otherwise indicated.
- B. All motor control components shall be NEMA design and horsepower rated. IEC design will NOT be acceptable.

## **2.2 CONTROL STATIONS**

- A. Control stations located in indoor dry areas shall be NEMA Type 12 (dust tight). Control stations located outdoors or in indoor wet areas shall be NEMA Type 4 (watertight). Control stations shall include push button units, selector switch units, pilot light units and/or other units as shown on the Drawings. Manufacturer's legend plates shall be installed as identified on the Drawings. Miniature type control devices shall not be used, unless otherwise indicated.
- B. Each control station shall have an interconnection point-to-point wiring diagram mounted inside the enclosure.
- C. Approved control station manufacturers shall be:
  - 1. Allen-Bradley
  - 2. Eaton
  - 3. ABB-GE
  - 4. Square D Company

## **2.3 PILOT LIGHTS**

- A. Pilot light units shall be NEMA Type 4/13 (watertight/oiltight), 30 or 30.5 mm round metal, panel mounted, 120 volts AC, push-to-test, full voltage type using high-intensity LED type lamps. Lamps shall be replaceable by removal of the color cap. Color of pilot lights shall be as indicated on the Drawings and as required by these Specifications.
- B. "RUN" or "ON" functions shall use green pilot light and "OFF" function shall use red pilot light. Pilot light color to be used for other functions shall be as indicated on the Drawings.
- C. Provide the device manufacturer's standard engraved collar legend nameplate to identify the function of each pilot light as indicated on the Drawings.
- D. Pilot lights shall be Allen-Bradley 800T or approved equal by Eaton, ABB-GE or Square D.

## **2.4 PUSH BUTTONS**

- A. Push button units shall be NEMA Type 4/13 (watertight/oiltight), 30 or 30.5 mm round metal, panel mounted. "START" push button units shall have a fully guarded or flush black button. "STOP" push button units shall have an unguarded or extended red button.
- B. Provide the device manufacturer's standard engraved collar legend nameplate to identify the function of each push button as indicated on the Drawings.
- C. Push buttons shall be Allen-Bradley 800T or approved equal by Eaton, ABB-GE or Square D.

## **2.5 SELECTOR SWITCHES**

- A. Selector switches shall be NEMA Type 4/13 (watertight/oiltight), 30 or 30.5 mm round metal, three-position, maintained contact, panel mounted with the Standard Operator, unless otherwise indicated.

- B. Provide the device manufacturer's standard engraved collar legend nameplate to identify the function of each selector switch as indicated on the Drawings.
- C. Selector switches shall be Allen-Bradley 800T or approved equal by Eaton, ABB-GE or Square D.

### **PART 3 - EXECUTION**

#### **3.1 GENERAL**

- A. Equipment shall be wired as shown on the Drawings and/or in accordance with approved coordinated wiring diagrams to provide the intended function.
- B. Control stations shall be rigidly secured and installed plumb and level. Connecting conduits shall not be used to support control enclosures unless specifically shown on the Drawings.
- C. Manually operated devices, such as push buttons, selector switches, and manual starters, shall be located to permit convenient operation.
- D. The Contractor shall furnish and install all conduit and wiring for control wiring as indicated on the Drawings.
- E. Mounted on the exterior surface of each control station shall be a laminated plastic nameplate in accordance with Section 260553 – Identification for Electrical Systems.

**END OF SECTION 262912**

## **SECTION 263213.13 – DIESEL-ENGINE-DRIVEN GENERATOR SET**

### **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 SCOPE**

- A. The Contractor shall furnish one new outdoor diesel-engine-driven generator set, along with all appurtenances, as specified herein and as shown on the Drawings, to provide 10-second start emergency standby power for the St. Louis Forensic Treatment Center - South.

#### **1.3 EXISTING CONDITIONS**

- A. Engine-generator set and access platforms shall be designed to suit available space and existing conditions.
- B. Prior to submitting engine generator submittals for review, Contractor and engine generator manufacturer's representative shall visit the site to observe existing conditions and take all measurement necessary to provide an engine generator which is fully coordinated with existing conditions.

#### **1.4 RELATED SECTIONS**

- A. Division 3 – Concrete
- B. Section 260500 – Common Work Results for Electrical
- C. Section 260526 – Grounding and Bonding for Electrical Systems
- D. Section 260529 – Hangers and Supports for Electrical Systems
- E. Section 260553 – Identification for Electrical Systems
- F. Section 260573 – Protective Device Coordination Study and Arc Flash Risk Assessment
- G. Section 260583 – Wiring Connections
- H. Section 260900 – Instrumentation and Control for Electrical Systems
- I. Section 262416 – Panelboards
- J. Section 263236 – Resistive Load Bank (Alternate Bid No. 2)
- K. Section 263290 – Generator Connection Cabinet
- L. Section 263623 –Automatic Transfer Switches, Open Transition
- M. Section 263623.13 – Automatic Transfer Switches, Closed Transition (Alternate Bid No. 1)



## **1.5 SECTION INCLUDES**

- A. The work covered under this section shall include, but not be limited to, the following items:
1. Packaged diesel engine-generator system with unit-mounted radiator and fan
  2. Generator control panel
  3. Remote annunciator panel
  4. Starting batteries, battery mat/wrap heaters and battery charger
  5. Sub-base mounted integral double wall fuel oil tank with leak detection, high- and low-level switches and fuel transfer system
  6. Seismic spring vibration isolators
  7. Sound attenuated, weatherproof, outdoor enclosure with radiator mounted resistive load bank and with exterior access platforms, stairs and guard rails. (Resistive load bank is Alternate Bid No. 2.)
  8. Critical exhaust silencer and stainless flex connector
  9. One (1) “ship loose” remote emergency stop push button and enclosure assembly
  10. Computer interface module with Modbus RTU and Modbus TCP/IP communications to allow control and monitoring of engine-generator set from Owner’s DDC building automation system (BAS)
  11. Lubrication oil and permanent antifreeze, including corrosion inhibitor
  12. Offloading of equipment at point of delivery
  13. Engine-generator set concrete foundation/support system
  14. Outdoor installation
  15. Diesel fuel for startup and operation of engine-generator set prior to substantial completion of the project
  16. One lot of spare filters and fan belts for the engine-generator set
  17. On site startup and resistive load bank testing of the engine-generator system
  18. On site Owner training on the engine-generator system

## **1.6 SUBMITTALS**

- A. Submit shop drawings and product data in accordance with the requirements of Section 260500 – Common Work Results for Electrical.
- B. Shop drawings shall be submitted for approval prior to release of the equipment for manufacturing and shall include, but not be limited to, the following:
1. Factory published specification sheet indicating standard and optional accessories, ratings, etc.
  2. Technical data sheet(s) identifying the make and model of the engine and generator including relevant component design and performance data
  3. Breakdown of all components and options to be included

4. Product data showing dimensions, weights, center of gravity for engine and generator, ratings, interconnection points, and internal wiring diagrams for engine, generator, control panel, battery charger, fuel tank, fuel transfer system, and remote annunciator
5. Manufacturer's catalog cut sheets of all auxiliary components such as electronic governor and actuator, voltage regulator, vibration isolators (including mounting diagram), batteries, battery mat/wrap heaters, battery rack, exhaust silencer, exhaust flex, jacket water heater(s), radiator and fan and generator output circuit breakers including electronic trip units and time current trip curves
6. Dimension drawings (plans and elevations) showing overall measurements, mounting locations, and interconnect point for electrical connections, fuel, exhaust, cooling and drains. The engine-generator set drawings shall include the engine and generator, all mounted on one common structural steel base which shall include a sub-base mounted integral fuel oil tank, all within a sound attenuated weatherproof enclosure with external access platforms, stairs and guard rails
7. Vertical and lateral reaction loads for the bearing points on the foundation/support system.
8. Interconnecting wiring diagrams and schematics for complete emergency system, including generator, output circuit breakers, sub-base fuel tank, battery charger, fuel transfer system, remote alarm indications and remote computer interface. These drawings shall be specific to the project component requirements and provided by the equipment manufacturer or the authorized dealer. Factory drawings that provide multiple interconnections for items not specific to the project will be rejected.
9. Engine mechanical data at varying loads up to full load, including heat rejection, exhaust gas flows and back pressure, combustion air and ventilation air flows, noise data, fuel consumption rate curves at various loads, cooling capacity (maximum ambient condition), etc.
10. Exhaust system calculations, in order to verify that the exhaust system does not violate the constraints of the generator maximum exhaust backpressure value
11. Emissions data, including emissions limits from referenced codes versus engine nominal emissions.
12. Certificates for compliance with EPA Emissions Standards for Compressed Ignition Engines
13. Generator electrical data including temperature and insulation data, cooling requirements, excitation ratings, voltage regulation, voltage regulator, efficiencies, waveform distortion and telephone influence factor
14. Engine and generator combination transient report at rated power factor for specific model supplied, of voltage and frequency transients response including recovery time at 50, 75 and 100% load application
15. Generator resistances, reactances and time constants
16. Generator current decrement curve
17. Generator motor starting capability
18. Generator thermal damage curve
19. Jacket water heater connection diagram

20. Control panel schematics
  21. Oil sampling analysis, laboratory location, and information
  22. Sub-base mounted integral fuel oil tank and fuel transfer system, including all accessories
  23. Sound attenuated, weatherproof, outdoor enclosure with external access platforms, stairs and guard rails
  24. Outdoor enclosure paint color sample chart or chips.
  25. Engine-generator set foundation/support system recommendations, layout and stub-up locations of electrical and fuel systems and anchor bolt recommendations for seismic restraint
  26. Engine-generator set sample test report
  27. Manufacturer's and dealer's written warranty disclosure statement for the period specified
  28. Location and description of supplier's parts and service facility within a one (1) hour drive time of the jobsite, including parts inventory, number of qualified technicians and service vehicles, normal and emergency telephone numbers and contact person.
- C. Provide seismic qualification certificate for the complete diesel-engine-driven generator assembly.
  - D. Submit information and pricing on engine-generator manufacturer's preventive maintenance contract options and extended service contract options. Preventive maintenance contract information shall clearly indicate the terms, conditions and cost of the contract, the frequency of preventive maintenance visits and all items to be tested, inspected, checked, etc. on each visit.
  - E. Extended service contract information shall clearly indicate the terms, conditions and cost of the contract, the length of the contract, any items not covered under the contract and the per visit deductible cost if applicable. Pro-rated type extended service contracts are not acceptable.
  - F. Authorized distributor shall provide copies of technician's factory training certificates specific to the proposed product on engine overhaul and electrical systems control repair in order to verify the level of support capabilities. Delegation of this service responsibility for any of the equipment listed herein will not be considered fulfillment of these specifications. Major engine and control parts shall be available within 24 hours from the time a component is deemed defective.
  - G. Operation & Maintenance Manuals: Provide O&M Manuals that describe installation, operation, and maintenance of the equipment furnished complete with all wiring and schematic diagrams within two weeks after the unit ships from the factory.
  - H. Submit operation and maintenance data under the provisions of Section 260500 – Common Work Results for Electrical and Article 3.5 of Section 007213 – General Conditions.
  - I. O & M Manuals shall be provided as follows:

1. Submit three (3) sets of manuals bound in 8-1/2 inch by 11-inch (A4) text pages, except drawings reduced to 11-inch by 17-inch pages may be folded for inclusion in the manuals. The manuals shall be provided in electronic (.pdf) format on a CD.
2. Each hard copy of the manuals shall be assembled and bound into hard-back, post-type binders suitable for rough usage. Three-ring, snap-ring type binders are not acceptable.
3. Prepare binder cover and spline inserts with printed title, "OPERATION AND MAINTENANCE INSTRUCTIONS FOR DIESEL-ENGINE-DRIVEN GENERATOR SET," title of project, project number, and subject matter of binder when multiple binders are required.
4. Internally subdivide binder contents with permanent page dividers, logically organized as described below, with tab titling clearly printed under reinforced, laminated, plastic tabs.
5. Operation and maintenance manuals shall include:
  - a. Table of contents
  - b. Appropriate design criteria
  - c. List of equipment
  - d. Parts list for each component
  - e. Operating instructions
  - f. Maintenance instructions for equipment and systems
  - g. Shop drawings and product data
  - h. Photocopies of warranties
  - i. Test reports
  - j. Manufacturer's detailed instructions for start-up, shutdown, operation and maintenance, including drawings, wiring diagrams and schematics for the engine, generator, and fuel tank
  - k. Bill of materials and manuals/data sheets for individual components
  - l. Manufacturer's recommended spare parts list
  - m. Manufacturer's recommended preventive maintenance schedule
  - n. Oil sampling and analysis for engine wear
  - o. Emergency maintenance procedures
- J. Manuals shall be conformed to "as-built" status by incorporating any and all changes made during the start-up period.

## **1.7 REFERENCES**

- A. The equipment covered by this section of the Specifications shall be designed, assembled and tested in accordance with the latest applicable ANSI, NEMA, UL, NFPA and EPA Standards, including, but not limited to:
  1. ANSI/NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum)
  2. ANSI/NEMA MG 1 – Motors and Generators

3. ANSI/NEMA MG 2 – Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators
  4. ANSI/NFPA 70 – National Electrical Code
  5. ANSI/NEMA AB 1 – Molded Case Circuit Breakers
  6. IEEE 3005 – Emergency and Standby Power Systems
  7. IEEE 3006 – Power System Reliability
  8. NEMA 250 – Enclosures for Electrical Equipment (1000V Maximum)
  9. NFPA 30 – Flammable and Combustible Liquid Code
  10. NFPA 37 – Installation and Use of Stationary Combustion Engines and Gas Turbines
  11. NFPA 99 – Health Care Facilities Code
  12. NFPA 101 – Life Safety Code
  13. NFPA 110 – Emergency and Standby Power Systems
  14. UL 142 – Steel Above Ground Tanks for Combustible Liquids
  15. UL 486A – Safety Wire Connections and Soldering Lugs for Use with Copper Conductors
  16. UL 508 – Industrial Control Equipment
  17. UL 508A – Industrial Control Panels
  18. UL 2200 – Stationary Diesel Engine Generator Assembly, 600 Volts Maximum
  19. Environmental Protection Agency (EPA) Emission Standards for Large Stationary Diesel and All Stationary Dual-fuel Engines, EPA AP42.
  20. Code of Federal Regulations 40 CFR Part 60, Subpart III – Standards of Performance for Stationary Compression Ignition Combustion Engines
  21. Code of Federal Regulations 40 CFR Part 89 Subpart B – Emission Standards and Certification Provisions
  22. Missouri Code of State Regulations 10 CSR 10 – 6.020 Definitions and Common Reference Tables
- B. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at property boundaries due to sound emitted by the engine-generator set, its components and the operation thereof.

## **1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver to project site and store and protect products at the project site in accordance with the provisions of Section 260500 – Common Work Results for Electrical.
- B. Accept packaged engine-generator set and accessories on site and document any and all damage upon receipt at the project site.
- C. Protect equipment from dirt and moisture by securely wrapping in heavy plastic.

- D. The engine-generator shall be delivered by truck to the project site in St. Louis, Missouri, where it shall be inspected for shipping damage, off-loaded and moved into place for final installation.
- E. Final timing of equipment delivery shall be coordinated by the Contractor to suit the construction schedule.

## **1.9 PROJECT RECORD DOCUMENTS**

- A. Submit record documents in accordance with the requirements of Section 260500 – Common Work Results for Electrical.
- B. Accurately record location of engine-generator and mechanical and electrical connections.

## **1.10 QUALIFICATIONS**

- A. Manufacturer: Company specializing in packaged engine-generator systems with minimum fifteen (15) years documented experience.
- B. To qualify as a manufacturer, the engine must be the principal item manufactured and the complete engine-generator set shall be supplied by that manufacturer's authorized distributor only.
- C. Supplier: Local authorized distributor of engine-generator manufacturer for the equipment supplied.
- D. The engine-generator set supplier must maintain a full parts and service center within sixty (60) miles of the project site and shall maintain 24-hour parts and service capability. The distributor shall stock parts as needed to support the engine-generator set package for this project and shall maintain an adequate staff of factory trained service personnel.

## **1.11 WARRANTY**

- A. The standby engine-generator and instrumentation panel shall be warranted by the manufacturer against defective materials and factory workmanship for a period of five (5) years from the date of substantial completion of the project in accordance with Article 3.4 of Section 007213 – General Conditions with a 2,500-hour term. Any and all defective parts shall be repaired or replaced at the manufacturer's option, free of charge including travel and labor during the term of the warranty.
- B. Warranty shall include an on-site temporary generator where repairs are expected to exceed 24 hours, or 1 day, to complete.
- C. The Owner shall be allowed to perform his own preventive maintenance on the unit during the warranty period without voiding the warranty. The Owner will keep a log of all maintenance on the unit to certify compliance with the engine-generator manufacturer's requirements as published in the O&M Manuals.
- D. Accessories such as silencer, sub-base fuel oil tank, and battery charger shall be warranted for a minimum period of 1 year from the date of substantial completion of the project in accordance with Article 3.4 of Section 007213 – General Conditions.
- E. Satisfactory warranty documents must be provided. Authorized distributor shall provide copies of factory authorization warranty repair certificates specific to the proposed product

on engine overhaul and electrical systems control repair in order to verify the level of support capabilities. Delegation of this service responsibility for any of the equipment listed herein will not be considered fulfillment of these specifications. Also, in the judgment of the specifying authority, the manufacturer supplying the warranty for the complete system must have the necessary financial strength and technical expertise with all components supplied to provide adequate warranty support.

#### **1.12 EXTRA MATERIALS**

- A. Provide five (5) spare indicator lamps of each size and type.
- B. Provide three (3) spare fuses of each size and type.
- C. Provide one (1) complete set of spare filters and fan belts for the engine-generator set.

#### **1.13 FACTORY TESTS**

- A. The engine-generator manufacturer shall perform all standard tests as required by NEMA, after the fabrication is complete and before shipping from the factory. Test runs shall be made over the full design load range. Any defects that become evident during these tests shall be corrected before shipping. A copy of the actual tests performed on this unit, including the results obtained, shall be designated as the "Test Report", and shall be submitted to the Designer for review and approval prior to shipment of the engine-generator set to the project site, and also shall be included as a part of the equipment O&M Manuals.
- B. Completely assembled engine, generator, and lubrication system shall be spin tested at the factory. The spin test shall check rotation, vibration, temperatures, oil leaks, engine trip devices and general operation.
- C. Included with the generator testing at the factory shall be the following:
  - 1. Resistance of the armature and the field windings
  - 2. Insulation resistance of all windings
  - 3. High potential test on all windings, phase-to-phase and phase-to-ground
  - 4. Air gap measurement
  - 5. Regulator operation test
  - 6. Exciter field current
  - 7. Voltage balance
- D. If the above testing is not available at the factory the engine-generator manufacturer's authorized service representative shall perform the tests and provide a test report as part of the start-up services.

### **PART 2 - PRODUCTS**

#### **2.1 ACCEPTABLE MANUFACTURERS**

- A. Subject to compliance with all requirements specified herein, provide products by one of the following:
  - 1. Caterpillar

Change in Scope, Re-Bid: Replace Emergency Generator, Infrastructure  
St. Louis Forensic Treatment Center - South, St. Louis, Missouri

M1908-01

2. Cummins
  3. Kohler
- B. The design of the diesel-engine-driven generator installation has been based on a Caterpillar, Inc., Model C32 diesel-engine-driven generator set in custom outdoor enclosure. Should the Contractor choose to include one of the approved equal manufacturers, he will be responsible for any additional costs resulting from physical changes and/or required accessories to make the equipment work with the existing conditions at the Facility.

## 2.2 GENERAL

- A. The packaged diesel-engine-generator set shall be a coordinated assembly of compatible components.
- B. The engine-generator set shall be a diesel-electric generator consisting of one liquid-cooled diesel engine directly coupled to one alternating current (AC) generator, mounted on a common rigid base consisting of cross-braced steel structural members.
- C. All equipment and materials shall be new, and where applicable, shall bear the Underwriters' Laboratories, Inc. (U.L.) Label of Approval. The electric generator shall be UL Listed and Labeled.
- D. Safety Standard: Comply with ASME B15.1.
- E. The engine-generator set shall have a rated output for standby service of 1000 kW, 1250 kVA at 0.8 power factor, including radiator fan and all parasitic loads, 480Y/277 volts, 3-phase, 4-wire wye connected, 60 hertz. The engine-generator set shall operate at a speed of 1800 revolutions per minute (RPM).
- F. Design parameters:
1. Site elevation .....570 ft.
  2. Site Design air temperature range..... -20°F to 115°F
  3. Maximum starting voltage dip .....25%
  4. Maximum generator winding temperature rise ..... 125°C
  5. Duty ..... Standby
  6. Fuel .....No. 2 ULSD Diesel
  7. Frequency .....60 Hz
  8. Generator speed ..... 1800 RPM
  9. Voltage.....480Y/277V, 3-phase, 4-wire wye connected
  10. Power factor..... 0.8
  11. Location ..... Outdoors
  12. Maximum exhaust system pressure at silencer outlet ..... 10 inches H<sub>2</sub>O
- G. The entire engine-generator assembly, as well as the means of fastening to the concrete foundation, shall be capable of withstanding seismic loads. The International Building Code – 2021 Edition and ASCE 7-16 – Minimum Design Loads for Buildings and Other



Structures shall be used as the design code with the specific environmental factors as stated below:

1. Earthquake Design Data:
  - a. Seismic Importance Factor:  $I = 1.5$
  - b. Risk Category: IV
  - c. Mapped Spectral Response Accelerations:  $S_s = 0.446$ ,  $S_1 = 0.160$
  - d. Site Class: D
  - e. Spectral Response Coefficients:  $SDS = 0.429$ ,  $SD1 = 0.243$
  - f. Seismic Design Category: D
  - g. Component Amplification Factor:  $A_p = 2.5$
  - h. Component Response Modification Factor:  $R_p = 2$
  - i. Overstrength Factor:  $\Omega_o = 2$
  - j. Analysis Procedure: Equivalent Lateral Force ASCE 7-16 Section 13.3
- H. The engine-generator set shall be mounted on a rigid structural steel sub-base which shall provide adequate strength and rigidity to maintain alignment of mounted components without depending on a concrete foundation. Mounting frame shall be free from sharp edges and corners and shall have lifting attachments arranged for lifting with slings without damaging components. Provide a rigging diagram permanently attached to the mounting frame to indicate the capacity of each lifting attachment and the generator-set center of gravity.
- I. Suitable seismic spring-type vibration isolators located between the engine-generator set and the rigid sub-base shall be provided. The isolation mountings shall consist of all steel welded top and bottom housings incorporating two or more steel springs and shall be provided with built-in leveling bolts and built-in resilient chocks to control oscillation and have an operating efficiency better than 90%.
- J. The quantity and size of the vibration isolators shall be as recommended by the manufacturer, and in general, shall be spaced approximately four (4) feet apart along the length and width of the engine-generator set.
- K. The engine-generator set shall be capable of starting and reaching rated voltage and frequency in a maximum time of 10 seconds and shall meet all requirements of NFPA-110, latest edition for a Level 1, Type 10, Class 96 emergency power supply (EPS).
- L. Power rating of the diesel engine-generator set shall be based on operation at rated RPM when equipped with all necessary operating accessories such as air cleaners, lubricating oil pump, fuel transfer pump, fuel injection pumps, jacket water pump, governor, alternating current generator, exciter regulator, and radiator fan. Rating shall apply at site conditions of 570 ft. above sea level and 122°F (50°C) ambient air temperature. The design air temperature range shall be from -20°F to +122°F.
- M. Nameplates: Each major system component shall be equipped with a nameplate to identify manufacturer's name and address, model and serial number, and component rating in integrated set and as required by the contract documents. The generator nameplate shall indicate all standard information as required by NEMA. The generator nameplate shall also

indicate the maximum three-phase and single-phase line-to-ground RMS symmetrical ampere fault capability at the rated voltage of the generator.

- N. Furnish a complete and coordinated control system which provides all necessary interfaces between the diesel engine-generator, and the generator auxiliaries. All necessary switches, starters, contactors, and overloads required for the generator auxiliaries shall be furnished.
- O. The diesel engine-generator set shall also meet the following requirements:
  - 1. The rated output voltage of 480 volts (line-to-line) shall have a manual adjustment of  $\pm 5\%$ .
  - 2. Voltage regulation shall not exceed  $\pm 0.5\%$ .
  - 3. Voltage steady-load bandwidth shall not exceed  $\pm 1\%$ .
  - 4. The voltage transient performance:
    - a. Dip, with step application of 25% load, shall not exceed 5%.
    - b. Rise, with step removal of 25% load, shall not exceed 5%.
    - c. Recovery time shall not exceed 1.5 seconds.
  - 5. The frequency shall be manually adjustable from 56 to 64 Hz.
  - 6. The frequency steady-load operational bandwidth shall not exceed  $\pm 0.5\%$  of rated frequency from no load to full load.
  - 7. The frequency transient performance:
    - a. Dip, with step application of 25% load, shall not exceed 3.6 Hz.
    - b. Rise, with step removal of 25% load, shall not exceed 3.6 Hz.
    - c. Recovery time shall not exceed 2 seconds.
- P. The diesel engine-generator shall consist of the following major components:
  - 1. Diesel engine
  - 2. Electric generator
  - 3. Generator output circuit breakers
  - 4. Generator control panel
  - 5. Radiator with fan
  - 6. Exhaust silencer (muffler)
  - 7. Batteries and battery charger
  - 8. Sub-base mounted integral dual wall fuel oil tank
  - 9. Fuel transfer systems:
    - a. Between existing underground fuel oil storage tank and engine generator sub-base tank
    - b. Between sub-base tank and engine
  - 10. Sound attenuated, weatherproof enclosure with access platforms and stairs
  - 11. Remote annunciator
  - 12. Remote computer interface

13. Remote emergency stop push buttons and enclosure

- Q. The engine-generator manufacturer shall design the controls for the entire emergency system, which shall encompass the diesel-engine-driven generator set and the generator control panel.
- R. The engine-generator manufacturer shall assume full responsibility for the coordination of all control wiring design between the components of the emergency system, and shall provide whatever interface components or contacts necessary to achieve this.

## 2.3 THEORY OF OPERATION

- A. The automatic transferring of the emergency loads throughout the facility from the normal source to the emergency generator power source shall be accomplished by means of one (1) existing medium-voltage, outdoor automatic transfer switch, four (4) existing (to be replaced on this project) 480V automatic transfer switches located in the main electrical room and fire protection room, and six (6) new automatic transfer switches located in the mechanical room. The new automatic transfer switches shall be provided in accordance with Section 263623 – Automatic Transfer Switches and Section 263623.13 – Automatic Transfer Switch for Fire Pump.
- B. The mode of operation shall be determined by the position of the Engine Control Switch (ECS) located on the Generator Control Panel. The ECS shall be a three-position selector switch having maintained contacts. The three (3) positions shall be (1) AUTOMATIC, (2) MANUAL or RUN, and (3) OFF/STOP.
- C. The following shall be the sequence of events when the Engine Control Switch is in the AUTOMATIC position:
  - 1. When any phase of the normal power source fails or drops below 70% of the rated voltage, the automatic transfer time delay “on” starting relay (“on delay” set for 3 seconds) located inside each of the automatic transfer switches shall be energized. When the time delay relay times out, the relay contact shall close, starting the emergency generator. When the generator reaches rated voltage and frequency, the automatic transfer switches shall automatically transfer the load from the normal (utility) source to the emergency generator.
  - 2. Upon restoration of normal power (when the normal voltage is greater than 90% of rated voltage in all three phases), the automatic transfer switches shall, after a time delay (set for 10 minutes), automatically retransfer the load back to normal power source. Then after an additional time delay (normally about 5 to 10 minutes) shall shut down the engine-generator set. Drop out and pick up voltages shall be factory calibrated.
- D. The following shall be the sequence of events when the Engine Control Switch is in the MANUAL position:
  - 1. The engine-generator set will automatically start immediately and come up to rated voltage and frequency. The engine-generator set shall then be manually controlled and shall continue to operate until the Engine Control Switch is turned to OFF/STOP or AUTO.
- E. The OFF/STOP position of the Engine Control Switch shall shut down the engine-generator set at the end of the cool-down time period.

- F. The Generator Control Panel shall include a red mushroom head EMERGENCY STOP push button that, when depressed, shall do the following:
1. Trip the generator circuit breaker and shut down the engine-generator set immediately without a cool-down time period.
  2. Two (2) additional EMERGENCY STOP push buttons, mounted on both sides of the exterior of the engine-generator set enclosure, when depressed, shall each perform this same function.
  3. One (1) additional remote mounted EMERGENCY STOP push buttons, when depressed, shall each perform this same function.

## 2.4 ENGINE

- A. The generating set drive shall be an inline or V-type, four-stroke-cycle, diesel fueled, electric ignition, internal combustion engine, liquid-cooled with a unit mounted radiator, fan, and water pump(s).
- B. Rating: Standby
- C. Engine Speed: 1800 RPM
- D. It shall be the responsibility of the engine-generator manufacturer to properly size the horsepower rating of the engine to operate properly at rated load at a speed of 1800 rpm.
- E. The engine shall be a compression ignition diesel and shall perform in accordance with all specifications and all applicable EPA emissions standards when operating on No. 2 Diesel fuel oil that complies with current Federal Regulation requirements for Ultra Low Sulfur Diesel of 15 PPM and manufacturer's fuel requirements.
- F. Emissions: Engine shall comply with the following emissions requirements.
1. Code of Federal Regulations 40 CFR Part 60, Subpart III
  2. Code of Federal Regulations 40 CFR Part 89.112
  3. Missouri Code of State Regulation 10 CSR 10 – Chapter 6
- G. Fuel System: Engine mounted diesel fuel pump and relief-bypass valve.
- H. Fuel Oil Sub-base Tank: The fuel oil shall be supplied from the engine-generator set's fuel oil sub-base tank. Level switches in the sub-base tank shall control a fuel oil duplex pump set located on the tank which will keep the tank full from the Owner's existing underground fuel oil tank.
- I. Lubrication System: Lubrication shall be full pressure as supplied by a gear type oil pump with strainer and thermostatic control valve capable of full flow and designed to be fail-safe. The engine shall have full flow fuel oil filter with replacement elements, fuel pumps, fuel filter, fuel strainer, air filters, full flow lube oil cooler with automatic bypass valve, full flow lubricating oil filter of the replaceable element type having an automatic bypass valve, service meter, gear-driven water pump, and instruments, including a fuel pressure gauge, water temperature gauge, and lubricating oil pressure gauge. All filters shall be the replaceable element type. Injectors shall be fuel limited (no load limit adjustments required). Provide crankcase drain arranged for gravity drainage with siphon or pump.

- J. Engine Jacket Heater(s): Thermostatically controlled jacket water heater(s) shall be provided to maintain proper coolant temperature while the engine is OFF. The jacket water heater(s) shall be engine-mounted thermal circulation tank-type immersion water heater incorporating an adjustable thermostatic switch. It shall maintain engine jacket coolant temperature in the range of 90°F to 120°F (32.2°C to 49°C) in a still air ambient temperature of -10°F (-23.3°C). The heater shall be 208-volt, single-phase or three-phase, with output rating as recommended by the engine manufacturer (minimum of 4.5 kW total at 208-volts), 60 Hz and shall be automatically turned OFF when the engine is operating. V-type engines shall have one heater per each bank of cylinders or one heater with a circulation pump. Provide a shut-off valve for each heater to allow for replacement of the heater without draining the entire coolant system.
- K. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator set mounting frame and integral engine-driven coolant pump.
1. The radiator shall have a vibration-free mounting, filler cap with pressure valve and vacuum valve, and a coolant system drain. The drain connection shall be at the lowest point in the cooling system. Drain piping shall be provided in accessible locations on the side of the base frame to permit complete draining of the entire cooling system.
  2. Fan and Core: Nonferrous-metal construction sized to contain expansion of total system. Blower type fan, sized to maintain safe engine temperature at full rated load in a maximum ambient temperature of 122°F based on 50/50 extended life coolant/water mixture.
  3. Radiator and blower shall be provided to accommodate an airflow restriction external to radiator of no less than 0.5 inches of water and as required for pressure drop through air intake and exhaust louvers and ductwork.
  4. Enclosure air intake and discharge systems shall be adequately sized for maximum combustion and radiator air flow.
  5. Inlet louvers, dampers, baffles, and/or sound-attenuating weather hoods shall be sized to resist rain water penetration into the enclosure. Provide 120VAC louver actuators, if required to keep the enclosure weatherproof on the inside. Actuators shall be powered close and spring return to open position when actuator power is removed.
  6. Outlet duct work shall be provided with the enclosure to deflect air flow from the radiator out the top of the enclosure. Provide "bird screen" over outlet. Provide drain in bottom of ductwork to prevent accumulation of water.
  7. A safety guard shall be provided for the fan, belt and pulleys.
  8. Coolant: Solution of 50 percent Extended Life Coolant (ELC) and 50 percent water, with anti-corrosion additives. The ELC provided shall meet or exceed the following specifications and guidelines: ASTM D-3306, TMC TP-329, ASTM D-6210, TMC RP-338 and SAE J1034.
  9. Provide expansion tank with site glass and low coolant level sensor.
- L. Governor: Engine speed shall be governed by a Woodward Model 2301A electronic, speed sensing, isochronous governor speed control or approved equal by the engine manufacturer. The engine governor shall maintain isochronous frequency regulation from no load to full rated load with hydraulic or hydro-electronic actuation. Steady-state operating band shall be  $\pm 0.25\%$ . The governor shall be capable of remote speed adjustment. The moving parts of the governor shall be automatically lubricated.

- M. If the engine-generator manufacturer's design requires a hydraulic actuator it shall be a Woodward Model EGB or approved equal hydro-electronic actuator by the engine manufacturer. Size of actuator shall be based on work output required.
- N. Engine Starting: 24-volt DC starting system with positive engagement drive of sufficient capacity to crank the engine at a speed which will start the engine under unfavorable operating conditions. One or two starter motors shall be provided in accordance with manufacturer's requirements. The starting pinion will disengage automatically when the engine starts. The starting system shall incorporate an automatically reset circuit breaker for anti-butt engagement. Include remote starting control circuit, with AUTO – MANUAL (RUN) – OFF/STOP selector switch on the Generator Control Panel.
- O. Battery-Charging Alternator: 45 amp minimum, factory mounted on engine with solid state voltage regulation.
- P. All wiring on the engine shall be rated for use in high ambient temperature areas, shall be harnessed or flexibly enclosed, shall be securely mounted on the engine to prevent chafing and vibration damage, shall terminate at the control panel in an enclosed box or panel and shall be connected to engine mounted devices at a junction box or through plug-in connectors.
- Q. The engine shall have pre-alarms provided for ENGINE (jacket water) LOW TEMPERATURE, LUBE OIL LOW PRESSURE, and ENGINE (jacket water) HIGH TEMPERATURE in accordance with NFPA 110. Safety shutoffs for ENGINE HIGH WATER TEMPERATURE, LOW OIL PRESSURE, ENGINE OVERSPEED, and ENGINE OVERCRANK shall be provided. Limits for pre-alarms and alarms shall be selected by the engine manufacturer.
- R. Digital engine monitoring shall be provided for the following items as part of the Generator Control Panel specified elsewhere in this Section.
1. Engine lubrication (lube) oil pressure
  2. Engine coolant temperature
  3. Engine running time (hours)
  4. Engine revolutions per minute (RPM)
- S. Exhaust System: Critical type silencer with minimum 30 dBA attenuation, sized for low pressure drop in accordance with engine manufacturer's instructions, and furnished with flexible stainless steel exhaust fittings and removable insulation blanket.
1. Silencer shall be welded, heavy duty carbon steel, horizontal, cylindrical or puck type, with bottom inlet(s), side outlet, companion flanges, minimum 2 inches of compressed thermal acoustical insulation inserted between the double shell construction of the silencer, support lugs, ANSI Class 150 flanged connections, inspection opening, and a threaded opening for connection of 3/4" drain line. Opening shall be flush on inside of silencer.
  2. Silencer shall be sized for minimum 30 dBA attenuation with less than 10" water column pressure drop at generator's rated capacity.
  3. Silencer shall be Universal, GT Exhaust Systems, Inc., Stoddard, InExhaust Innovative Exhaust Solutions, Inc. or approved equal.
  4. Exhaust flexible fittings shall be suitably sized stainless flexible bellows.

5. Silencer insulation blanket shall be custom made with “glove fit” to silencer with knitted stainless steel wire mesh inside ply, resin-free fiberglass insulation, silicone impregnated fiberglass outer ply, and stainless-steel hooks and tie wires.
  6. Exhaust system shall be designed and furnished to accommodate the available enclosure space above the engine-generator and properly supported, braced, and guyed from the enclosure as required to accommodate gravity, wind, and seismic loads.
  7. Exhaust shall extend a minimum of 12’ above grade and terminate with a suitably sized, counter-weighted, rain cap which minimizes exhaust backpressure on the engine.
- T. The following diesel engine accessories shall be included.
1. Exhaust driven turbochargers(s) or supercharger as applicable
  2. Aftercoolers, if required
  3. Exhaust silencer and stainless-steel expansion joint(s) or flexible connectors
  4. Exhaust rain cap
  5. Intake air silencer as required
  6. Dual element air intake filters
  7. Stainless steel expansion joint or flexible connection for turbocharger air intake, if offered
  8. Starting battery charging alternator, 45 amp minimum
  9. Engine coolant water expansion tank or steel pipe, if required
  10. Coolant water radiator with cooling fan(s)
  11. Thermostatically controlled jacket water heater(s)
  12. Flexible lines and connectors shall be provided for:
    - a. Fuel oil supply to engine
    - b. Fuel oil return(s) from engine
    - c. Jacket water supply
    - d. Jacket water return
  13. Fuel cutoff valves
  14. Pumps
    - a. Fuel priming (manual)
    - b. Fuel transfer
    - c. Gear driven water
  15. Primary duplex fuel water separator with bypass valves to provide the ability to isolate each filter independently for changing while the engine is running.
  16. All required fuel and lubricating oil filters, strainers and accessories including, but not limited to:
    - a. Fuel filter
    - b. Fuel return cooler

- c. Lube oil filter
- d. Lube oil cooler
- 17. Crankcase breather
- 18. Governor actuator (if applicable)
- 19. Over crank and overspeed sensors with contacts for annunciation and engine shutdown
- 20. Ball valves for drainage of jackets, etc., shall be provided in the intercooler and main jacket water circuits
- 21. One lot of lube and extended life coolant solutions
- 22. Engine mounted terminal panel with terminal blocks, to serve as a central wiring point for all items located at the engine
- 23. Oil Drain: A suitable drain for lubricating system shall be provided with cap and valve located to permit easy access. The drain pipe shall be extended out beyond the engine-generator base and rigidly supported. The drain shall be mounted a minimum of 6" above the vibration isolators.
- 24. All the required instruments and control with all the required piping, valves and fittings.

## 2.5 GENERATOR

- A. The generator shall be an alternating current (AC) synchronous machine having a synchronous revolving field and a brushless exciter. The generator shall be 480Y/277 volt, 60 hertz, three-phase, four-wire, wye connected, six-winding, 1800 RPM, single-bearing, wet wound, tropicalized, having four (4) poles and built to ANSI/NEMA MG 1 standards. The pole faces shall contain complete (full) amortisseur windings.
- B. Power Rating: The generator shall have an electrical power (ekW) rating of 1000 ekW/1250 kVA for standby service at a power factor of 0.8 for continuous duty, with Class H temperature rise (125°C temperature rise over 40°C ambient, by resistance).
- C. Motor Starting Capability: Minimum of 2,126 skVA at 25% voltage dip at 0.4 power factor.
- D. Subtransient Reactance ( $X''_d$ ): Maximum of 0.1573 per unit direct axis.
- E. Enclosure: Open drip-proof self-ventilated, air-cooled, with air flow through screened louvers.
- F. Insulation: Class H insulation shall be used on the stator and rotor, and both shall be further protected with a Vacuum Pressure Impregnation (VPI) system using Class H epoxy resin, which shall provide moisture, chemical, abrasive resistance, and fungus protection on all coils.
- G. Windings: 2/3 pitch form or random wound stator winding that optimizes generator efficiency and minimizes total harmonic distortion, especially 5th and 7th harmonics which are detrimental to AC motors.
- H. Strip Heater: Thermostatically controlled located inside the generator housing to prevent moisture condensation by maintaining stator windings above dew point. The strip heaters



shall automatically be turned OFF whenever the engine-generator set is in operation. Strip heaters and control shall be 120 volts AC, single-phase, 60 hertz.

- I. Provide winding temperature detectors and monitoring.
- J. Harmonic Distortion: Less than 5% total harmonic distortion at rated power factor, full load voltage and RMS current. Maximum single harmonic shall not exceed 3%.
- K. Telephone Influence Factor: Less than 50 based on 1960 weightings.
- L. Rotor: Rotating field type furnished complete with a 3-phase, rotating brushless AC exciter rotor and rectifier assemblies mounted on a common shaft within the generator stator frame. The generator field and exciter rotor coils shall be securely supported and held in place to prevent movement caused by electrical and rotational forces. Rotors shall be dynamically balanced with AC exciter rotor and rectifier assemblies mounted. The generator rotor shall be dynamically balanced within 0.0005-inch (0.0127 mm) peak-to-peak amplitude displacements at both ends of shaft and shall sustain 25% overspeed.
- M. Exciter: Rotating Permanent Magnet Generator (PMG) pilot exciter to provide constant voltage and automatic field flashing for the generator field via the Voltage Regulator. Capacity shall be sufficient for operating the generator at rated voltage and kVA without exceeding total "hot spot" temperature. The constant output voltage from the PMG pilot exciter shall be fed to the input power terminals on the Voltage Regulator. The DC output from the Voltage Regulator shall be fed to the brushless exciter field. When the generator rotor begins to turn, the PMG rotating magnetic field shall produce a voltage in the PMG stationary armature winding. The output voltage from this PMG armature winding then shall be used to power the Voltage Regulator.
- N. The PMG shall provide "current boost capability" to the generator, thereby supporting 300% rated current for ten seconds when a short circuit occurs.
- O. The exciter AC output shall be converted to DC by means of a full wave solid-state rectifier mounted on the generator armature. All rectifier diodes shall be non-aging, metallic, hermetically sealed, silicon type. Diodes shall be carefully selected and conservatively rated for long life. Diodes shall be mounted on heat sinks to effectively dissipate diode heat.
- P. Voltage Regulator: Automatic volts-per-hertz type, solid-state or magnetic amplifier Voltage Regulator manufactured by the generator manufacturer or approved equal shall be mounted inside the Generator Control Panel or shock mounted inside the generator. Voltage regulation shall be  $\pm 0.5\%$  of rated voltage from no load to full rated load, controlling the exciter field current as required to maintain a constant and stable generator output voltage. A 5% variation in frequency and the effects of field heating shall not affect the unit's regulation performance. The unit shall have frequency compensation which aids system block load pickup performance and controls excitation when operating below synchronous speed. Shorting the regulator output shall not damage the regulator.
- Q. Readily accessible voltage droop, voltage level, and voltage gain controls shall be included in the voltage regulator module. The regulator shall have three phase sensing with the sensing circuit isolated from the power stage.

- R. Electro-magnetic interference suppression shall be an integral part of the voltage regulator. Thermal protection for power semi-conductors, inherent over-voltage protection, and fuse protection for extreme overcurrent shall be provided internally in the regulator.
- S. The voltage regulator module shall include the following protective features:
1. Current limit circuits shall restrain the exciter field current while allowing full forcing voltage to be applied to obtain rapid response during transient conditions or service overloading on the generator.
  2. A time-delay circuit shall sense the overcurrent limit operation and cut off all field current to the generator after ten seconds.
- T. A Manual Voltage Control (MVC), providing a  $\pm 5\%$  minimum voltage adjustment, shall be provided on the front of the Generator Control Panel.
- U. The engine, generator, regulator, and governor combination shall permit FULL RATED BLOCK LOAD application with speed and voltage recovery within six seconds after full load application.
- V. The generator shall be designed and constructed to withstand three-phase line fault currents.
- W. Bearings: Antifriction, regreasable or sealed type with B-10 life of 50,000 hours. Bearings shall be insulated where necessary to prevent the flow of "shaft current". Bearing housing shall be designed to prevent the entrance of lubricant into the generator enclosure, or dirt into the bearings.
- X. Provide bearing temperature detectors and monitoring.
- Y. Provide a metal enclosed terminal compartment with accessible bolted covers for connecting the generator output leads to each generator circuit breaker.
1. Provide tin- or silver-plated copper bus bars, sized per applicable codes and UL standards, for phase and neutral installed on insulated stand-offs.
  2. Provide copper equipment ground bus sized per applicable codes and UL standards.
  3. Bond the equipment ground bus to the metal enclosure with an ultra-flexible stranded copper bonding jumper sized per applicable codes and UL standards.
  4. Bond the neutral bus to the equipment ground bus with an ultra-flexible stranded copper system bonding jumper sized per applicable codes and UL standards.
- Z. The generator shall have a corrosion resistant nameplate in a conspicuous location with the following minimum data:
1. Manufacturer's name and location
  2. Serial number
  3. Model/type
  4. Kilovolt-ampere (kVA) rating
  5. Kilowatt (kW) rating
  6. Power factor

7. Time rating
  8. Temperature rise ( $^{\circ}\text{C}$ ) for rated continuous load
  9. Rated speed in RPM
  10. Line voltage (volts AC)
  11. Rated line current in amperes AC
  12. Number of phases
  13. Frequency (hertz)
  14. Exciter field voltage (volts DC)
  15. Generator field voltage (volts DC)
  16. Engine bore and stroke
  17. Engine firing order
  18. Direct Axis Subtransient Reactance,  $X''_d$  (ohms)
  19. Direct Axis Transient Reactance,  $X'_d$  (ohms)
  20. Direct Axis Synchronous Reactance,  $X_d$  (ohms)
- AA. The engine-generator shall be provided with a large red nameplate in a prominent location with 1/2" high white lettering stating the following:

**DANGER!**

THIS IS A FULLY AUTOMATIC  
EMERGENCY SYSTEM CONTROL.  
ENGINE MAY START AT ANY TIME!

DO NOT REMOVE COVERS OR  
ATTEMPT MAINTENANCE WITH  
ENGINE IN AUTOMATIC MODE.

- BB. The generator shall be manufactured by the engine-generator manufacturer or by:
1. Kato Engineering Company
  2. Leroy Somer
  3. Lima Electric Co., Inc.
  4. Marathon Electric Manufacturing Corporation
  5. Magnetek Electric Co.

## **2.6 GENERATOR OUTPUT CIRCUIT BREAKERS**

- A. The engine-generator set shall be equipped with generator main line output circuit breakers.
1. 1600AF/1500AT for generator output connection to the new main emergency switchboard specified in Section 262413 – Switchboards.
  2. 600AF/600AT for generator radiator mounted resistive load bank (Alternate Bid No. 2)

- B. The breakers shall be vibration isolated mounted to the side of the engine-generator set with the breaker line side connected directly to the generator output.
- C. The circuit breakers shall be molded case type with solid state electronic trip unit located in a NEMA Type 1 or Type 12 surface shock mounted enclosure. Wire bending space within the enclosure for each circuit breaker shall meet the requirements of NEC Tables 312.6.
- D. The circuit breaker and circuit breaker enclosure combinations shall be 600 volts AC, 3-pole, with ampere rating as indicated herein and on the project one-line diagram and shall be UL Listed for 100% continuous load operation in accordance with NEC 215-3 (Ex. No. 1). The breakers shall have a minimum interrupting rating greater than the maximum fault that could be produced at the load terminals of the breaker, 35 kA minimum.
- E. Do not order circuit breakers for the generator until the required short-circuit current ratings have been determined in accordance with Specification Section 260573 – Protective Device Coordination Study and Arc Flash Risk Assessment.
- F. The breakers shall be built in accordance with Underwriters' Laboratories Standard 489, NEMA Standard AB-1 (latest revision), and Federal Specification W-C-375B/GEN, as Class 23a.
- G. The breakers shall have an over-center, trip-free, toggle-type operating mechanism having quick-make, quick-break action with positive handle indication for ON, OFF, and TRIP positions. The breaker shall provide common tripping of all poles.
- H. The breakers shall contain a solid-state electronic tripping unit having the following features:
  - 1. Rating plug
  - 2. Long-time current pickup and delay
  - 3. Short-time current pickup and delay
  - 4. Instantaneous current pickup
  - 5. Ground fault current pickup and delay (trip or alarm only as indicated on the Drawings)
- I. Provide NEC 240.87 compliant arc energy reduction maintenance system for output circuit breaker with an ampere frame size  $\geq 1200A$ . The arc energy reduction maintenance system shall be as provided by the circuit breaker manufacturer with selector switch and blue pilot light, indicating when maintenance mode is selected, mounted in the front of the circuit breaker enclosure.
- J. The breakers shall be capable of operating in any position.
- K. The breakers shall be provided with a 24VDC shunt trip device connected to the engine-generator safety shutdowns.
- L. All generator output breakers shall be provided with two (2) Form "C" normally open/normally closed sets of auxiliary contacts to indicate circuit breaker open/closed position. Contacts shall be rated 10A @ 125-250 VAC.

- M. Conductors from generator terminal compartment bus bars to line side of all generator circuit breakers shall be ultra-flexible stranded copper sized per applicable codes and UL standards.
- N. Two-hole, long-barrel, mechanical, set screw type lugs, sized for the generator feeder conductors as shown on the drawings, shall be supplied on the load side of each breaker.
- O. Provide kirk-key interlock on the 1600A output circuit breaker to interlock it with the 1600A breaker in the "Main Emergency Switchboard" (MESB), as indicated on the project one-line diagram, for temporary mobile generator connection as indicated on the Drawings.
- P. The main line circuit breaker shall be manufactured by:
  - 1. Square D Company
  - 2. Eaton
  - 3. ABB

## **2.7 GENERATOR CONTROL PANEL**

- A. A local Generator Control Panel shall be provided for complete control and monitoring of the engine-generator set. Control panel shall be housed in a NEMA Type 1 or NEMA Type 12, surface mounted, dead front, 14-gauge (minimum) steel enclosure mounted on the wall next to the engine-generator set or mounted on the engine-generator set itself. Mounting method shall isolate the control panel from engine-generator set vibration. Critical components shall be environmentally sealed to protect against failure from moisture and dirt.
- B. The Generator Control Panel shall include, but shall not be limited to, the following items/features:
  - 1. Automatic start/stop operation of engine-generator set by means of a complete 2-wire automatic engine start-stop control which starts the engine on closing contacts and stops the engine on opening of the contacts.
  - 2. Cyclic cranking limiter with crank and rest cycles, individually adjustable shall be provided to open the starting circuit after eight attempts if the engine has not started within that time.
  - 3. Adjustable cooldown timer (may be included in automatic transfer switches per Section 263623 – Automatic Transfer Switches)
  - 4. Emergency Stop push button
  - 5. Three (3) position AUTO / MANUAL (RUN) / OFF/STOP Engine Control Switch (ECS)
  - 6. True RMS sensing digital AC metering (0.5% true RMS accuracy) with phase selector switch
    - a. Generator output alternating current (AC) voltage (L-L)
    - b. Generator output alternating current (AC) voltage (L-N)
    - c. Generator output alternating current (AC) amperes
    - d. Generator frequency, accuracy  $\pm 0.195$  hertz
    - e. Generator output kilowatts (kW) – Total and per phase

- f. Generator output kilovolt-amperes (kVA) – Total and per phase
  - g. Generator output kilovolt-amperes-reactive (kVAR) – Total and per phase
  - h. Generator output power factor – Overall and per phase
  - i. Generator output percentage of rated power output
  - j. Generator output kilowatt-hours (kWhr)
  - k. Generator output kilovolt-ampere-hours (kVAhr)
  - l. Generator output kilovolt-ampere-reactive-hours (kVARhr)
7. Digital engine monitoring
- a. Lubrication oil pressure
  - b. Coolant temperature
  - c. Revolutions-per-minute (RPM)
  - d. Running time (hours)
  - e. Engine successful start counter
  - f. Engine crank attempt counter
  - g. Service maintenance interval
  - h. Fuel consumption (gal/hr)
  - i. Air filter differential pressure
  - j. Boost pressure
  - k. Engine crankcase pressure
  - l. Engine exhaust temperature (single or left and right)
  - m. Engine intake manifold temperature
  - n. Engine oil temperature
  - o. Fuel filter differential pressure
  - p. Fuel pressure
  - q. Oil filter differential pressure
  - r. Oil temperature
  - s. Fuel temperature
8. Digital display of system direct current (DC) voltage
9. Generator voltage adjustment for the voltage regulator
10. Governor isochronous speed control
11. Frequency control
12. Engine run (ER) relay with 120 VAC, 10-amp Form "C" contacts that change state when the engine is running
13. Engine run auxiliary relay with three (3) sets of 120 VAC, 10-amp, Form "C" contacts brought out to terminal strips. The relay shall operate on generator start and run.

14. Common fault relay with 120VAC, 10-amp Form “C” dry contacts that change state for a generator fault condition shall be provided for customer use.
15. 120VAC, 10-amp dry contact for interlocking with the weatherproof enclosure intake and exhaust louver actuators such that the contact opens upon generator start command to cause the louvers to open.
16. Provide a Local Generator Annunciator Panel in compliance with NFPA 99 and NFPA 110 for a Level 1 system with LED indicating lights and 24 VDC alarm horn. Include the listed pre-alarm and alarm points, audible alarm, alarm silencing means, repetitive alarm circuitry, and lamp test switch in a NEMA Type 1 or 12 painted steel enclosure. Provide all required sensors and contacts to annunciate both visually and audibly the following at the local generator annunciator panel and on the generator control panel LCD:
  - a. Overcrank Shutdown
  - b. Low Water Temperature Alarm
  - c. High Engine Temperature Pre-alarm and Shutdown
  - d. Low Lube Oil Pressure Pre-alarm and Shutdown
  - e. Overspeed Shutdown
  - f. Low Fuel Alarm
  - g. Low Coolant Level Alarm
  - h. EPS Supplying Load
  - i. Control Switch Not in Auto Alarm
  - j. High Battery Voltage Alarm
  - k. Low Cranking Voltage Alarm
  - l. Low Battery Voltage Alarm
  - m. Battery Charger Failure Alarm (includes AC failure)
  - n. Emergency Stop
  - o. Overload Alarm
  - p. Common Alarm (Activates on all above alarms and all other alarms that are displayed on the generator control panel display but not on the local annunciator.)
17. Provide all required sensors and contacts to annunciate both visually and audibly the following on the generator control panel. The following alarms shall be annunciated/displayed at the generator control panel LCD and shall light the “Common Alarm” on the generator local annunciator panel:
  - a. Generator Breaker Open
  - b. Fuel Tank Leak Alarm
  - c. Engine Low Temperature Alarm
  - d. Fuel Tank High Level Alarm
  - e. Fuel Tank Control System Fault Alarm
  - f. High Intake Manifold Air Temperature Alarm

- g. High Intake Manifold Air Temperature Shutdown
  - h. High Lube Oil Temperature Alarm
  - i. Undervoltage Alarm
  - j. Overvoltage Alarm
  - k. Over Frequency Alarm
  - l. Under Frequency Alarm
  - m. Fuel Filter Restriction Alarm
  - n. ERMS Mode Switch On
  - o. Generator Breaker Open
  - p. Reverse Power Alarm
  - q. Low Fuel Pressure Alarm
  - r. Low Fuel Pressure Shutdown
  - s. High Fuel Pressure Alarm
  - t. High Fuel Pressure Shutdown
- 18. Audible alarm, 24 volts DC, flush mounted, 101 dB(A) at 10 feet; Edwards Type 871-G1, or approved equal
  - 19. Alarm Acknowledge/Horn Silence push button
  - 20. LAMP TEST push button for testing lamps in all of the pilot and annunciator lights on the control panel door, as well as the audible alarm
  - 21. Main thermal-magnetic circuit breaker to disconnect all power within the control panel
  - 22. Automatic voltage regulator specified elsewhere in this Section
  - 23. Isochronous electronic governor speed control specified elsewhere in this Section
- C. An overspeed device shall be provided for the unit separate from the governor to automatically stop the engine should the speed exceed 115-120% of rated speed. The overspeed trip shall be immediate in action and shall be of a type which must be reset by hand. An emergency shutdown device shall be incorporated with the overspeed trip. The generator main circuit breaker shall trip "open" when this device is activated.
  - D. All adjustments used for regulating the voltage, speed, fuel, cooling water, lubricating oil pressure and such parts shall be shock mounted.
  - E. The control panel shall incorporate self-diagnostics capabilities and fault logging.
  - F. The control panel shall have digital LCD indication and LED indicating lights, for alarms and pre-alarms. The control panel shall have "key-pad" programmability and shall have a backup means for the program, EPROM or long-life lithium battery, such that the system memory and program data is not lost in the event of a control power (engine starting battery) failure.
  - G. Control panel shall be suitable for operation in a 20°F to 120°F, 0 to 100% relative humidity environment.



- H. The emergency generator control panel shall include a Modbus RTU (RS-485) output registry for an interface by the systems integrator for communication with the Owner's BAS. The generator control panel shall also include Ethernet communications; Modbus TCP/IP (RJ45).
- I. Generator control panel shall be Caterpillar Model EMCP 4.3 or approved equal by Cummins or Kohler.

## **2.8 REMOTE ANNUNCIATOR**

- A. Provide a Remote Generator Annunciator Panel in compliance with NFPA 99 and NFPA 110 for a Level 1 system with LED indicating lights and 24 VDC alarm horn. Include the listed pre-alarm and alarm points, audible alarm, alarm silencing means, repetitive alarm circuitry, and lamp test switch in a flush mounted panel with standard NEMA Type 1 painted steel enclosure. Provide all interconnecting wiring in conduit per manufacturer's requirements by the Electrical Contractor. The remotely reported alarms shall include the following:
  - 1. Overcrank Shutdown
  - 2. Low Water Temperature Alarm
  - 3. High Engine Temperature Pre-alarm and Shutdown
  - 4. Low Lube Oil Pressure Pre-alarm and Shutdown
  - 5. Overspeed Shutdown
  - 6. Low Fuel Alarm
  - 7. Low Coolant Level Alarm
  - 8. EPS Supplying Load
  - 9. Control Switch Not in Auto Alarm
  - 10. Low Cranking Voltage Alarm
  - 11. Emergency Stop
  - 12. Overload Alarm
  - 13. Generator Running
  - 14. Generator Breaker Open
  - 15. Fuel Tank Leak Alarm
  - 16. Common Alarm (Activates on all above alarms and all other alarms that are annunciated/displayed at the generator control panel but not on the remote annunciator.)
  - 17. The following alarms that are annunciated/displayed at the generator local control panel shall light the "Common Alarm" on the Remote Annunciator Panel:
    - a. High Battery Voltage Alarm
    - b. Low Battery Voltage Alarm
    - c. Battery Charger Failure Alarm (includes AC failure)
    - d. Engine Low Temperature Alarm
    - e. Fuel Tank High Level Alarm

- f. Fuel Tank Control System Fault Alarm
  - g. High Intake Manifold Air Temperature Alarm
  - h. High Intake Manifold Air Temperature Shutdown
  - i. High Lube Oil Temperature Alarm
  - j. Undervoltage Alarm
  - k. Overvoltage Alarm
  - l. Over Frequency Alarm
  - m. Under Frequency Alarm
  - n. Fuel Filter Restriction Alarm
  - o. ERMS Mode Switch On
  - p. Reverse Power Alarm
  - q. Low Fuel Pressure Alarm
  - r. Low Fuel Pressure Shutdown
  - s. High Fuel Pressure Alarm
  - t. High Fuel Pressure Shutdown
- B. Audible alarm shall be 24 volts DC, flush mounted, 101 dB(A) at 10 feet; Edwards Type 871-G1 or approved equal.
  - C. Provide Alarm Acknowledge/Horn Silence push button.
  - D. Provide Lamp Test push button for testing all indicator lights on the remote annunciator.
  - E. The remote annunciator shall interface to the General Control Panel specified elsewhere in this Section. Any required relay contacts to activate the alarms on the remote annunciator shall be provided.
  - F. The remote annunciator module shall be environmentally sealed and housed in a NEMA 1 or NEMA 12 enclosure for flush mounting in a gypsum board wall where indicated on the Drawings.
  - G. All inputs and outputs shall be protected against short circuits to (+/-) battery and shall have reverse polarity protection.
  - H. The remote annunciator(s) shall be suitable for operation in a 20°F to 120°F, 0 to 100% relative humidity environment.

## 2.9 BATTERY AND BATTERY CHARGER

- A. Furnish and install a 24-volt DC battery system and battery charger for the engine-generator set. Charger and batteries shall be located in a readily accessible location inside the engine-generator set sound attenuated weatherproof enclosure.
- B. Batteries: The batteries shall be lead-acid heavy duty storage type having electrolyte as required and as specified by the manufacturer for engine starting at jobsite conditions. The batteries shall be sized and rated by the battery manufacturer in accordance with the requirements set forth by the engine manufacturer for proper starting of the engine under

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"worst case" conditions at an ambient temperature of -10°F but shall be rated no less than 140-ampere hours / 1000 CCA per battery. Batteries shall be capable of cranking engine at rated ambient for a minimum of three minutes, based upon a 60-second cycle consisting of 30 seconds cranking time and 30 seconds rest time resulting in a total elapsed time period of 6 minutes.

- C. The minimum battery life shall be 3 years at jobsite conditions.
- D. A battery rack and necessary insulated ultra-flexible stranded copper cables and clamps shall be provided, for location alongside the engine. The positive ("+") cable shall have red colored insulation and the negative ("-") cable shall have black colored insulation.
- E. Battery cables shall be provided of adequate size to assure proper starting voltage is maintained during engine cranking. Termination of the battery leads shall be clearly marked on the power unit as "positive" and "negative." The markers shall be attached to the unit in such a manner that they will not become detached during shipment.
- F. Provide a battery disconnect switch.
- G. A seismic rated battery rack assembly shall be provided. Insulating material shall be added to the battery rack assembly for isolating batteries. Battery rack shall be painted with acid-resistant paint and shall comply with NEC Article 480.
- H. Batteries shall be heavy-duty, high-rate discharge type, manufactured by Caterpillar, Exide, Gould, or approved equal.
- I. Provide 120VAC, single-phase, 60 Hz battery mat/wrap heaters with thermostat in accordance with NFPA 110, Article 3-3.1.
- J. Battery charger: UL listed, solid state, 24-volt DC, fully automatic, 20 amp minimum, two-rate, full-wave rectifier, wall mounted, float/equalize type, housed in a NEMA Type 1 or NEMA Type 12 enclosure. Mount in a readily accessible location within the engine-generator set sound attenuated weatherproof enclosure. Charger shall have means for adjusting the high and low rates, complete with charge light and power "on" lights. Provide with temperature compensation. Charger high rate shall be capable of recharging a discharged battery up to 100% of full capacity within 8 hours. When batteries reach full charge, charger shall automatically taper off charging current according to battery manufacturer's instructions. After battery is fully charged, charger shall automatically switch to low rate. The low rate shall be a trickle charging current sufficient to maintain batteries in a fully charged condition. Battery charger shall automatically be disconnected from the battery during the cranking period of the diesel engine and automatically reconnected to the battery immediately after cranking.
- K. Charger shall require a 120-volt, 60 hertz input, and shall maintain rated output voltage within  $\pm 1\%$  from no load to full load with AC input variations of  $\pm 10\%$ .
- L. Charger shall have a DC voltmeter (2% accuracy) and a DC ammeter (5% accuracy) mounted on the front door of the charger enclosure.
- M. Charger shall have automatic overload protection (current limiting), and fused AC input and DC output. The charger shall have a built-in alarm feature which shall sense a charger failure due to low DC battery voltage or loss of AC voltage input and shall announce such failure by activating the alarm contact. The alarm contact shall consist of a separate

individual isolated normally closed contact which shall be annunciated on the local Generator Control Panel annunciator, as BATTERY CHARGER FAILURE. Include alarms per NFPA 110 for Level 1 system.

- N. Charger shall be permanently marked with the allowable range of battery unit capacity, nominal output current and voltage, and sufficient battery-type data to allow replacement batteries to be secured.
- O. Battery charger output and performance shall be compatible with the batteries furnished, including the maintenance charge rate.
- P. Battery charger shall be adjusted for charging the specific lead-acid batteries provided, and shall be Alcad SLR Series; Exide SCR Series; or approved equal by C&D Charter Power Systems, LaMarche Manufacturing Company or Sens.
- Q. A thermometer, a hydrometer, a temperature correction chart, and an instruction booklet providing information on how these items are to be used for maintenance purposes, shall be provided, unless the batteries are "maintenance free" type.

## **2.10 FUEL OIL SUB-BASE TANK**

- A. Provide fuel oil sub-base tank which is an integral part of the engine-generator set base.
- B. The tank shall be designed and constructed in accordance with UL 142 and shall comply with the applicable requirements of NFPA 30, 37, and 110. Tank shall be heavy gauge (minimum 3/16" plate), welded carbon steel, double wall (containment) design and shall be UL 142 listed and labeled.
- C. Tank shall have a minimum usable capacity of 2,000 gallons of No. 2 diesel fuel at maximum fill (fuel oil fill pump shutoff).
- D. Tank shall be suitably stiffened to support the engine-generator set with sound attenuated weatherproof enclosure and serve as the support base for the unit.
- E. Steel anchor plates shall be provided under the tank to act as shims to elevate the tank above the concrete foundation and to provide for anchoring the tank to the concrete foundation with anchor bolts. Anchorage system shall be as required to meet the seismic requirements.
- F. Seismic vibration isolators shall be provided as specified herein and shall be located between the fuel oil tank and the engine-generator set.
- G. Tank shall be coated with manufacturer's standard corrosion resistant, exterior grade coating.
- H. The tank shall have provisions for direct filling from a fuel oil truck and from a remote underground fuel oil storage tank.
  - 1. Tank shall include a factory-mounted, alternating, duplex fuel oil pump system suitable for transfer of fuel oil from a remote underground storage tank to sub-base tank.
  - 2. All required connections, valves, strainers, instruments, controls, and spill containment for both means of filling shall be provided.

- I. All tank connections shall be above the normal maximum oil fill level and shall include anti-siphon provisions as required.
- J. The fuel oil sub-base tank shall include, but not be limited to, the following connections:
  - 1. Truck fuel fill: 2" NPT with lockable hose connection cap, spill box, overflow prevention valve, and dip tube
  - 2. Remote storage fuel fill: Minimum 2" NPT, with dip tube
  - 3. Remote storage fuel return/overflow: Minimum 2" NPT
  - 4. Fuel oil hand pump fill: Minimum 2" NPT, with dip tube.
  - 5. Tank level indication: As required
  - 6. Tank vent: As required, minimum 2" NPT
  - 7. Containment basin vent: As required, minimum 2" NPT
  - 8. Containment basin drain with valve and plug: Minimum 3/4" NPT
  - 9. Containment basin leak system for remote alarm: As required
  - 10. Tank low level switches: As required
  - 11. Tank high level switches: As required
  - 12. Engine Fuel supply: As required, with dip tube
  - 13. Engine Fuel return: As required, with dip tube
  - 14. Emergency vents (tank and containment): As required
  - 15. Primary tank inspection port: Minimum 6".
  - 16. Spare Connections: One, minimum 2" NPT.
- K. Sub-base Tank Fuel Oil Transfer System: The tank shall include a factory-packaged, fully automated, fuel oil supply system suitable for transfer of fuel oil from a remote underground storage tank to the sub-base tank. Fuel oil transfer system and associated electronic control system shall be UL 142 and 508 listed and labeled. Fuel oil transfer system shall include, but not be limited to, the following:
  - 1. Duplex fuel oil gear pumps with alternating lead/lag controls
    - a. Each pump shall have a capacity greater than the full load engine fuel consumption, with a minimum of 15 inches of mercury (15" Hg) of total suction lift at sea level.
  - 2. Fuel oil supply isolation valve (lockable).
  - 3. Fuel oil supply strainer.
  - 4. Pump suction pressure indicator.
  - 5. Pump suction isolation valves (lockable).
  - 6. Low Fuel Level Switch– Alarm – local/remote.
  - 7. Critical Low Fuel Level Switch – Engine Shutdown, Alarm – local/remote.
  - 8. Fuel Level Switches – Lead Pump On/Off
  - 9. Fuel Level Switches – Lag Pump On/Off.
  - 10. High Fuel Level – Supply Pumps Shutdown, Alarm – local/remote.

11. Critical High Fuel Level – Supply Pumps Shutdown, Alarm – local/remote.
12. Rupture basin leak detector - Supply Pump Shutdown and alarm – local/remote.
13. Enclosed industrial control panel with UL 508A listing and labeling, including, but not limited to the following:
  - a. Microprocessor based control system.
  - b. Standard 120 VAC, single phase, 60 Hz power supply
  - c. Power supply status indicator
  - d. AC/DC circuit breakers
  - e. On/Off/Emergency switch(es)
  - f. Control system test/reset switch(es)
  - g. LED indicators for all functions and alarms
  - h. Manual/automatic pump control
  - i. Pump status indicators
  - j. Fuel level indicators
  - k. Motor control relays with LED signals
  - l. Local alarms
  - m. Dry relay contacts (NO/NC) for remote annunciation of alarms, pump status, and control system fault
- L. Auxiliary Hand Pump: an auxiliary hand pump shall be provided with the tank, in the event that the motorized fuel pumps become disabled.
  1. The auxiliary hand pump shall be piston or rotary type, and capable of pumping 20 gallons per 100 strokes, self-priming to 20' lift.
  2. Hand pump suction isolation valves shall be included.
- M. Fuel oil piping shall be schedule 80 carbon steel with carbon steel threaded fittings.
- N. The fuel oil tank shall include all trim and accessories as required by the applicable codes and regulations including, but not limited to, the following:
  1. Overfill protection.
  2. Protected level gauge to locally indicate fuel level inside the tank. Mount on tank level connection.
  3. Fuel oil return temperature indicator.
  4. Anti-siphon valve(s) as required.
  5. Normal vents (tank and containment) of corrosion resistant construction with weather, debris, and insect resistant vent caps.
  6. Emergency vents (tank and containment) of corrosion resistant construction with weather, debris, and insect resistant caps.
  7. Minimum 5-gallon spill box at fuel tanker fill cap connection.

## **2.11 ENGINE-GENERATOR SET ENCLOSURE**

- A. Provide a factory installed, sound attenuated, durable, weather protective enclosure of minimum 14-gauge cold rolled steel or aluminum with ambient capability of -20°F to 122°F.
- B. Enclosure shall be designed and insulated as required to provide for a maximum full load sound level of 80 dBA at 23 feet from the enclosure.
- C. Enclosure shall be “reach-in” type sized as required to house the engine-generator set including all appurtenances and a radiator mounted 500kW resistive load bank with automatic loading controls in accordance with Specification Section 263236 – Resistive Load Bank. (Resistive Load Bank is Alternate Bid No. 2.)
- D. Enclosure shall have removable, hinged doors, and removable end panels to allow easy access for routine maintenance. All hinges, latches and locks shall be rust-free stainless steel with zinc-plated or stainless-steel hardware. Doors shall be lockable and equipped with rubber seals and shall be located as required to provide secure access to fuel fill, oil fill, coolant fill, generator control panel, main line output circuit breakers, shore power distribution panelboard, resistive load bank automatic load control panel, battery, battery charger and fire extinguishers. (Resistive Load Bank is Alternate Bid No. 2.)
- E. Enclosure roof shall be pitched to prevent moisture accumulation.
- F. Enclosure shall be painted utilizing environmentally friendly, electrostatically applied polyester power baked paint. Color shall be white, beige, ANSI 61 light gray, ANSI 49 gray or manufacturer's standard subject to Owner's approval. Enclosure color will be selected as part of the shop drawing submittal review process.
- G. The exhaust silencing system shall be housed within the enclosure for operator safety and maximum life of silencer.
- H. Lube oil, coolant and fumes disposal lines shall be terminated on the base frame for easy access.
- I. Enclosure shall have skid base with dragging points and fork pockets, compatible with attachment to and support on existing structure reinforced by others.
- J. A radiator sight gauge shall be provided for easy verification of coolant level from the ground.
- K. Enclosure design shall incorporate a side or end-mounted control panel, shore power distribution circuit breaker panelboard for generator auxiliary loads; jacket heaters, battery charger, battery mat/wrap heaters, generator strip heater, enclosure unit heater, GFCI receptacles, and generator output circuit breakers. Control panel, shore power distribution panelboard and generator output circuit breakers shall be vibration isolation mounted.
- L. Enclosure shall include an adequate quantity of interior 24 VDC LED maintenance lights to service the generator, day or night. The lights shall be automatically turned on and off by opening and closing any of the hinged access doors.
- M. Provide an exterior 24VDC LED photocell controlled light above the main access doors on both sides of the generator set enclosure.

- N. Enclosure shall have a safety glass viewing window at the control panel for easy viewing from outside the enclosure without opening any doors or access panels.
- O. Provide aluminum or hot-dipped galvanized steel access platforms on both sides of the enclosure with 42" high guard rails and stairs with guard rails on both sides. Access platform sizes shall be as indicated on the Drawings.
- P. A 20-ampere, 120-volt AC, 60 hertz, 2-pole, 3-wire grounding, straight blade, NEMA 5-20R, 5 milliampere ground fault circuit interrupter duplex receptacle, meeting the requirements of Section 262726 – Wiring Devices, shall be provided in a convenient location inside both sides of the enclosure. These receptacles shall be circuited to the generator circuit breaker panelboard located inside the engine-generator set enclosure.
- Q. Alternate Bid No. 2: Provide a factory installed, radiator mounted resistive load bank with automatic load step controls in accordance with Specification Section 263236.
- R. Due to existing condition space constrains at the project site, the maximum dimensions of the generator enclosure, including the access platforms and stairs on both sides, shall be:
  - 1. Length: 27'-5"
  - 2. Width: 15'-0"

## 2.12 ACCESSORIES

- A. Remote Manual Stop Stations (Emergency Power Off – EPO): Provide three (3) red, mushroom head, maintained contact type emergency power off (EPO) push buttons in a NEMA Type 4 stainless steel or painted, cast aluminum control enclosure for emergency shutdown of the generator.
  - 1. One (1) factory mounted at the access door on the exterior of both sides of the engine-generator set enclosure (for a total of two factory mounted EPO push buttons) as indicated on the Drawings, with clear, UV resistance spring loaded hinged cover with provisions for padlocking.
  - 2. One (1) shipped loose for installation by in the main electrical room inside the building as indicated on the Drawings
- B. EPO push buttons shall be of the same type and design as the EPO push button mounted in the Generator Control Panel.
- C. The engine-generator manufacturer shall provide automatic monitoring of the EPO switches. The remote EPO shall be field wired and the two (2) EPOs mounted on the outside of the engine-generator set weatherproof enclosure shall be factory wired to the Generator Control Panel and the radiator mounted resistive load bank such that activation of any of the EPO push buttons, including the one on the Generator Control Panel, shall shut down the engine-generator immediately without a cool-down time period, shut down the resistive load bank, trip the generator main line output circuit breakers open, and initiate a visual and audible alarm at each generator annunciator panel. (Resistive Load Bank is Alternate Bid No. 2.)
- D. Provide an engraved laminated plastic nameplate on all generator EPO push button enclosures with 1/4-inch-high engraved white characters on a red background with the following wording:



GENERATOR  
E-STOP

- E. Engine return fuel cooler if required.
- F. Generator Shore Power Distribution Panelboard: Provide circuit breaker distribution panelboard mounted in a readily accessible location within the diesel-engine-driven generator enclosure, with and integrally mounted surge protective device, for the distribution of “shore power” to all diesel-engine-driven generator set loads. The panelboard shall be provided in accordance with Specification Section 262416 – Panelboards.
- G. Radiator Mounted 500kW Resistive Load Bank: Provide in accordance with Specification Section 263236 – Resistive Load Bank – Alternate Bid No. 2.
- H. Load bank shall be mounted inside the engine-generator set weatherproof enclosure, on the output side of the radiator, in accordance with the load bank manufacturer’s written instructions.
- I. The load bank automatic loading control panel shall be mounted in a readily accessible location within the engine-generator set weatherproof enclosure.
- J. All power wiring from the 100% continuous load rated 600A/3P main line output circuit breaker to the load bank and all control wiring to all generator EPO push buttons and between the load bank and the load bank control panel shall be factory installed by the engine-generator set supplier.
- K. Provide 120VAC control power to the load bank and/or load bank control panel from the shore power circuit breaker panelboard inside the engine-generator set weatherproof enclosure.
- L. Install appropriately sized CT on one set of phase leads in the circuit breaker enclosure for the 1600A main line output circuit breaker and wire to the load bank control panel as the building load inputs to the automatic loading control system.
- M. All power and control wiring shall be installed in accordance with the load bank manufacturers written instructions.
- N. Fire Extinguishers: Provide a minimum of two (2) fire extinguishers inside the engine-generator set enclosure in accordance with NFPA 37. Fire extinguishers shall be mounted to the inside of the enclosure in a readily accessible location

**2.13 MISCELLANEOUS**

- A. All moving parts shall have metal guards to prevent entanglement of falling objects and provide personnel protection.
- B. The complete engine-generator unit shall be given a finish coat of the manufacturer's standard heat-resisting enamel.
- C. Furnish one (1) quart of the touch-up paint or the equivalent quantity of aerosol spray cans.
- D. In addition to all items specified above, the following items shall be included and installed:
  - 1. Lubrication oil

2. Braided flexible copper bonding straps having a minimum width of one inch and a minimum length of 10 inches properly attached between the generator frame and the engine-generator set base, and between the engine block and the base.
3. One oil sampling kit for the engine shall be provided, with instructions for proper use, in order to forecast and minimize engine downtime.
4. One lot of spare filters for the engine-generator as recommended by the manufacturer.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that surfaces are ready to receive work and field dimensions are as shown on the Drawings.
- B. Verify that required utilities are available in proper location and ready for use.
- C. Beginning of installation means installer accepts existing conditions.

### **3.2 INSTALLATION**

- A. Install in accordance with manufacturer's instructions and referenced standards.
- B. Install "shipped loose" items in accordance with the engine-generator manufacturer's written instructions and as indicated on the Drawings.
- C. Generator supplier shall provide assistance to the Contractor with the installation of all "shipped loose" items at the project site as required.
- D. Provide conduit and wiring/cabing in accordance with the engine-generator manufacturer's written instructions and as indicated on the Drawings to connect the various components of the emergency power system together to make a complete and functioning system.
- E. Batteries shall not be installed until the battery charger is in service.
- F. Install the remote EPO push button in the location inside the building shown on the Drawings. Provide 24V DC power wiring in conduit as required. Coordinate installation with the manufacturer approved shop drawings and wiring diagrams.

### **3.3 ARC FLASH HAZARD WARNING LABELS**

- A. Provide an arc flash hazard warning label on front exterior of the enclosure of each main line output circuit breaker and the resistive load bank mounted on the radiator inside the engine-generator set weatherproof enclosure in accordance with Sections 260553 - Identification for Electrical Systems and 260573 – Protective Device Coordination Study and Arc Flash Risk Assessment. (Resistive Load Bank is Alternate Bid No. 2.)

### **3.4 START-UP SERVICES**

- A. Field inspection and testing will be performed under provisions of Section 260500 – Common Work Results for Electrical and in compliance with NFPA 37, NFPA 99 and NFPA 110 requirements.

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- B. The engine-generator supplier shall include the services of factory authorized field technician(s) for the following:
1. Verify that all equipment is installed properly
  2. Check all auxiliary devices for proper operation including batteries and battery charger, jacket water heater(s), generator anti-condensation heater, generator control panel, remote annunciator, remote computer interface, fuel tank, etc.
  3. Test all alarms and safety shutdown devices for proper operation and annunciation
  4. Check all fluid levels
  5. Start engine and check for exhaust, oil and fuel leaks, vibrations, etc.
  6. The Contractor shall verify proper voltage and phase rotation at each automatic transfer switch before connecting to the load
- C. The engine-generator manufacturer's authorized service representative shall fill the entire cooling system (radiator, jacket water, and intercooler) with properly mixed coolant consisting of 50% water and 50% extended life coolant including the manufacturer's recommended type and quantity of anti-corrosion additives. All coolant shall be thoroughly mixed BEFORE placing into the cooling system radiator at the factory or job site when the radiator ships loose. Coolant shall be placed into the cooling system through the fill cap opening of the radiator.
- D. Prior to any testing, and before starting the diesel engine, the engine-generator manufacturer's authorized service representative shall perform the following:
1. Fuel, lubricating oil, and coolant shall be checked for conformity to the manufacturer's recommendations under the environmental conditions present and expected.
  2. Accessories that normally function while the set is in standby shall be checked prior to cranking the engine. This shall include, but not be limited to: engine jacket water heater(s), battery charger, and generator anti-condensation heater.
  3. Tests shall be made to check for exhaust leaks, cooling air flow, movement during starting and stopping, vibration during running, normal and emergency line-to-line voltage, and phase rotation.
  4. Prior to the electrically loading of the engine-generator set, the controls shall be tested for normal operation.
- E. Provide portable resistive load bank (to be used in conjunction with the 500kW radiator mounted resistive load bank if Alternate No. 2 is accepted) for full load testing of the engine-generator set. Simulate power failure including operation of automatic transfer switches, automatic starting cycle, and automatic shutdown, and return to normal.
- F. The Contractor shall fill the sub-base fuel tank prior to start of test. The Designer and the Construction Representative shall be notified two (2) weeks in advance of the time and date of this test.
- G. The on-site installation test shall be conducted as follows:
1. With the prime mover in a "cold start" condition and the building load at standard operating level, a primary power failure shall be initiated by opening all switches or circuit breakers supplying the primary power to the normal source terminals of each automatic transfer switch or with Facility Representative's approval, the

normal source main circuit breaker and load-interrupter switch may be opened to simulate the loss of utility power condition.

2. The test load shall be the load that is served by the Emergency Power Supply System (EPSS).
3. The time delay on start shall be observed and recorded.
4. The cranking time until the prime mover starts and runs shall be observed and recorded.
5. The time taken to reach operating speed shall be observed and recorded.
6. The voltage and frequency overshoot shall be recorded.
7. The voltage, frequency, and amperes shall be recorded.
8. The prime mover oil pressure and water temperature shall be recorded, where applicable.
9. The battery charge rate shall be recorded at 5-minute intervals for the first 15 minutes and at 15-minute intervals thereafter.
10. When primary power is returned to the facility, the time delay on retransfer to primary for each switch with a minimum setting of 5 minutes shall be recorded.
11. The time delay on the prime mover cool-down period and shutdown shall be recorded.
12. Allow prime mover to cool for 5 minutes.
13. A resistive load shall be applied for a 4-hour, full load test. The building load shall be permitted to serve as part of the load, supplemented by the radiator mounted resistive load bank and a portable resistive load bank of sufficient size to provide a load equal to 100 percent of the nameplate rating of the Emergency Power Supply (EPS), less applicable derating factors for site conditions.
14. The full load test shall be initiated immediately after the cooling time has expired by any method that starts the prime mover and, immediately upon reaching rated rpm, picks up 100 percent of the nameplate kW rating on one step, less applicable derating factors for site conditions.
15. During test, record the following at 5-minute intervals for the first 15 minutes and every 15 minutes for the rest of the test:
  - a. Kilowatts
  - b. Amperes
  - c. Voltage
  - d. Frequency
  - e. Coolant temperature
  - f. Enclosure temperature (interior)
  - g. Oil pressure
  - h. Engine exhaust temperature
  - i. Engine inlet temperature
  - j. Oil Temperature
  - k. Battery charge rate

16. Upon completion of the test and after a cool down period, the crank/rest cycle shall be tested.
    - a. Any method recommended by the manufacturer for the cycle crank test shall be utilized to prevent the prime mover from running.
    - b. The control switch shall be set at “run” to cause the prime mover to crank.
    - c. The complete crank/rest cycle shall be observed and recorded.
  17. Test alarm and shutdown circuits as typically performed by the generator supplier.
  18. Correct of all malfunctions such as the elimination of all oil and water leaks, miss-wiring and improper control functions found during testing.
- H. The engine-generator manufacturer's authorized service representative shall provide all of the necessary metering and measurement equipment required for all testing.
- I. Coordinate load bank testing with Construction Representative at least 2 weeks in advance so Owner can make arrangements to infrared scan the power terminations in all new equipment. Provide access to terminations in all new equipment for Owner’s IR scan technician.
- J. After the test run is concluded and systems have been demonstrated to be satisfactory and ready for permanent operation, all permanent pipe line strainers and filters shall be cleaned, air filters cleaned or replaced, valve and pump packings properly adjusted, belt tensions adjusted, drive guards secured in place, lubrication checked and replenished, if required. Temporary piping, ducting, wiring, instrument connections, etc., shall be removed, and openings restored in a permanent manner acceptable to the Construction Representative.
- K. Contractor shall fill sub-base fuel tank and main fuel tank upon completion of testing.
- L. Submit test report(s) with test results and indicating time and date of testing and names of individuals present during testing to the Designer for record.

### **3.5 ADJUSTING**

- A. Adjust generator output voltage and engine speed.

### **3.6 CLEANING**

- A. Clean work under provisions of Divisions 00 and 01 and Section 260500 – Common Work Results for Electrical
- B. Clean engine and generator surfaces.

### **3.7 DEMONSTRATION**

- A. Provide systems demonstration. Coordinate the demonstration schedule with the Construction Representative and the Designer.
- B. Describe loads connected to emergency and standby systems and restrictions for future load additions.
- C. Simulate power outage by interrupting normal source and demonstrate that system operates to provide emergency and standby power.

### **3.8 TRAINING**

- A. Provide four (4) hours of on-site training by factory trained field service engineer to instruct the Owner's personnel in the proper operation and routine maintenance of the equipment. Review operation and maintenance manuals, parts manuals and emergency service procedures. This shall be done after completion of the acceptance testing in two sessions, one in a.m. and one in p.m. Training session shall be video recorded by the engine-generator supplier and two (2) copies of the video on DVD shall be provided to the Construction Representative.

**END OF SECTION 263213.13**

## **SECTION 263236 – RESISTIVE LOAD BANK**

### **ALTERNATE BID NO. 2**

#### **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 SCOPE**

- A. This specification contains the minimum requirements for the design, manufacture and testing of a UL listed, air-cooled, radiator or enclosure top mounted resistive load bank.
- B. The load bank is required for periodic exercising and testing of the (standby) emergency power source. The load bank shall be factory mounted to the radiator of the diesel-engine-driven generator, inside the generator set weatherproof enclosure, in accordance with Section 263213.13 – Diesel-Engine-Driven Generator Set.

##### **1.3 RELATED SECTIONS**

- A. Section 260500 – Common Work Results for Electrical
- B. Section 260519 – Low-Voltage Electrical Power Conductors & Cables
- C. Section 260526 – Grounding and Bonding for Electrical Systems
- D. Section 260529 – Hangers and Support for Electrical Systems
- E. Section 260533.13 – Conduit for Electrical Systems
- F. Section 260553 – Identification for Electrical Systems
- G. Section 260573 – Protective Device Coordination Study and Arc Flash Risk Assessment
- H. Section 260583 – Wiring Connections
- I. Section 262813 – Fuses
- J. Section 263213.13 – Diesel-Engine-Driven Generator Set

##### **1.4 SUBMITTALS**

- A. The manufacturer shall submit for review technical data including features, performance, electrical characteristics, physical characteristics, ratings, accessories, and finishes.
- B. Shop drawings shall include dimensional plans and mounting details sufficient to properly install the load bank. Load bus configuration and load connections termination area shall be clearly identified.
- C. Electrical schematic drawings shall be provided to detail the operation of the load bank and the provided safety circuits. Over-current protection and control devices shall be identified

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and their ratings marked. A system interconnection drawing shall be included for control wiring related to the load bank.

- D. Provide recommended spare parts list, including pricing.

## **1.5 STANDARDS**

- A. The equipment covered by this specification shall be designed with the latest applicable ANSI, IEEE, NEMA and NFPA standards.
- B. The load bank shall be listed to UL 508A or UL 891 as certified by a nationally recognized testing laboratory (NRTL) such as CSA, Intertek ETL or UL by application of the NRTL's label on the load bank enclosure.

## **PART 2 - PRODUCTS**

### **2.1 RATINGS**

- A. The total capacity of the load bank shall be rated 500 kW at 480 Volts, 3-Phase, 3-Wire, 60 Hertz, 600 Amps per Phase at unity Power Factor and 50 kW minimum load step resolution.
- B. The load bank shall be designed for continuous duty cycle operation with no limitations. The load bank shall operate in an ambient temperature of -28°C to 50°C (-20°F to 122°F).
- C. The load bank shall have a minimum short circuit current rating (SCCR) of 14 kA at 480VAC and the SCCR shall be listed on the equipment rating plate.
- D. Do not order the resistive load bank until the required short-circuit current ratings have been determined in accordance with Specification Section 260573 – Protective Device Coordination Study and Arc Flash Risk Assessment.

### **2.2 MATERIAL AND CONSTRUCTION**

- A. The load bank shall be suitable for installation on the generator radiator core, within the radiator exhaust ductwork, or on the roof of the generator set enclosure.
- B. Due to the high radiator exhaust from the generator set, the load bank shall be constructed of heavy gauge aluminized steel per ASTM A463. Aluminized steel provides superior corrosion protection and extended service life, with a better tolerance to high heat exposure compared to the more common galvanized steel.
- C. The main input load bus, load step relays, fuses and control relays shall be located within the load bank enclosure. A thermostatically controlled heater shall be located within the control section to provide protection to the control devices from the effects of moisture and condensation.
- D. The load bank core size shall be as required by the Specification Section 263213.13 – Diesel-Engine-Driven Generator Set supplier.
- E. The load bank shall be designed for installation and operation outdoors and shall have a screened exhaust or a louver.



- F. The load bank shall have manufacturer's standard color baked polyester powder coated paint finish with a film thickness of 2.8 +/- 0.4 mils per coat.

## **2.3 RESISTIVE LOAD ELEMENTS**

- A. Load elements shall be ASCO Helidyne™ or approved equal, helically wound chromium alloy rated to operate at approximately one-half of maximum continuous rating of wire. Elements must be fully supported across the entire length within the air stream by segmented ceramic insulators on stainless steel rods. Element supports shall be designed to prevent a short circuit to adjacent elements or to ground.
- B. The change in resistance due to temperature shall be minimized by maintaining conservative watt densities.
- C. The overall tolerance of the load bank shall be -0% to +5% kW at rated voltage. A -5%, +5% rating allows the load bank to deliver less than rated kW and shall not be used. The load bank must deliver full rated kW at rated voltage.
- D. Sealed wire type elements (which have the internal resistance wire totally enclosed) prevent internal cooling of the element wire and shall not be used.

## **2.4 COOLING**

- A. The 1000kW diesel-engine-generator set radiator fan shall provide the air flow necessary to cool the load bank. Coordinate cooling requirements with the supplier of the Specification Section 263213.13 – Diesel-Engine-Driven Generator Set.
- B. The load bank shall have a maximum static pressure drop at design velocity as specified by the engine-generator set supplier.

## **2.5 PROTECTIVE DEVICES**

- A. An over-temperature switch shall be provided to sense the load bank exhaust. The switch shall be electrically interlocked with the load application controls to remove load from being applied in the event of an over temperature condition.
- B. To provide for major fault protection, branch fuses shall be provided on all three phases of switched load steps. Branch fuses shall be current limiting type with an interrupting rating of 200kAIC.
- C. The exterior of the load bank shall have appropriate warning/caution statements on access panels.

## **2.6 CONTROL PANEL**

- A. The control panel shall be a remote 19" panel housed in a NEMA Type 4 wall mount enclosure. The control panel shall contain the following manual controls:
  - 1. Power ON/OFF switch
  - 2. Master load ON/OFF switch
  - 3. Load step switches for ON/OFF application of individual load steps
- B. Control panel visual indicators shall be as follows:

1. Power ON indication light
  2. OVERTEMPERATURE light
- C. A standard remote load dump circuit shall be provided as part of the load bank control circuit. Provisions shall be provided to remove the load bank off-line from the operation of a remote normally closed set of auxiliary contacts from a transfer switch or other device. In the event of the remote contact opening, all load is removed.
- D. An Automatic Load Step Controller shall be provided for maintaining a minimum load on the engine-generator set. The controller shall monitor the connected downstream loads and will automatically add or subtract load steps in response to building load changes as to maintain a minimum load level on the engine-generator set. The controller shall include an initial time-delay circuit, and automatic time delayed load step application circuit. A remote contact closure shall initiate activation and transfer of control. Provide an adequately sized current transformer for installation on one set of phase leads on the load side of the 1600A generator main line output circuit breaker to sense all facility load on the generator.
- E. The load bank shall have a digital monitoring system with real-time data logging software. The monitoring system shall provide a 3-line extra-bright LED display of voltage, current, frequency and power measurements. The software interface to the meter shall allow for real-time data acquisition and data logging from a laptop PC. An IrDA/USB adapter shall be provided for plug and play convenience.

## 2.7 DOCUMENTATION

- A. Installation and operation manuals shall be provided with the equipment and shall include complete details for the installation, commissioning, operation, and maintenance of the load bank.
- B. The manuals shall include the electrical schematic and interconnect drawings for the power and control wiring for the load bank and all control devices.
- C. A complete parts list with part numbers, device identification, and rating shall be included in the manuals. The original manufacturers name and part number shall be included in the parts listing.
- D. Three (3) hard copy sets of manuals shall be provided with the load bank.

## 2.8 ACCEPTABLE MANUFACTURERS

- A. The load bank shall be as manufactured by:
1. ASCO Power Technologies, Avtron Load Bank Products  
6255 Halle Drive  
Cleveland, Ohio 44125  
Phone: 216-573-7600  
Email: [customercare@ascopower.com](mailto:customercare@ascopower.com) | Web: [loadbanks.ascopower.com](http://loadbanks.ascopower.com)
  2. Loadtec Load Technology, Inc.  
525 Commerce Circle  
Mesquite, NV 89027-1900  
Phone: 800-562-3832  
Email: [sales@loadtec.com](mailto:sales@loadtec.com) | Website: [www.loadtec.com](http://www.loadtec.com)

3.       Simplex, Inc.  
          5300 Moon Road  
          Springfield, Illinois 62711-6228  
          Phone: 800-637-8603  
          Email: [johnh@simplexdirect.com](mailto:johnh@simplexdirect.com) | Website: [www.simplexdirect.com](http://www.simplexdirect.com)

## **2.9       QUALITY CONTROL**

- A.    The load bank shall be fully tested using a test specification written by the supplier. Tests shall include electrical functional testing, verifying conformance to assembly drawings and specifications. Each load step shall be cold resistance checked to verify proper calibration of resistive load steps and proper ohmic value.
- B.    The manufacturer shall maintain the test data on file for inspection purposes by the purchaser. Tests using high potential equipment shall be performed to ensure isolation of the load circuits from the control circuits and to determine isolation of the load circuits from the load bank frame. Tests of all safety circuits shall be performed to verify conformance to the specification.
- C.    All electrical circuits shall have a high potential insulation resistance test performed at twice rated voltage plus 1000 VAC to assure insulation integrity.
- D.    All quality control test equipment shall be regularly maintained and calibrated to traceable national standards.
- E.    The manufacturer's quality control system shall be ISO9001 Certified.

## **2.10      QUALIFICATIONS OF MANUFACTURER**

- A.    The load bank shall be manufactured by a firm regularly engaged in the manufacture of load banks and who can demonstrate at least twenty-five (25) years' experience with at least twenty-five (25) installations of load banks similar or equal to the ones specified herein.
- B.    The manufacturer shall have a written quality control procedure available for review by the purchaser, which will document all phases of operations, engineering, and manufacturing.
- C.    Manufacturer must have a field service organization with service personnel having a minimum of an Associate Degree in Electrical Engineering.
- D.    The manufacturer shall have a service organization capable of providing on-site service within a four (4) hour time frame.

## **2.11      WARRANTY**

- A.    Manufacturer shall warrant equipment to be free from defects in materials and workmanship, including the resistors, for a minimum period of one (1) year from date of substantial completion of the project.

# **PART 3 - EXECUTION**

## **3.1       INSTALLATION**

- A. Equipment shall be installed in accordance with the manufacturer's written instructions by the supplier of the Specification Section 263213.13 – Diesel-Engine-Driven Generator Set.
- B. The automatic load bank control panel shall be mounted in a readily accessible location inside the engine-generator set weatherproof enclosure.
- C. All power and control conduit and wiring shall be terminated at the load bank and load bank control panel in accordance with the manufacturer's written instructions and equipment drawings. Final conduit connections to equipment shall be with liquidtight flexible metal conduit (LFMC) in accordance with Specification Section 260533.13 – Conduit for Electrical Systems at the locations indicated on the manufacturer's equipment drawings.
- D. Connect power and control cables to load bank and automatic control panel as indicated on the equipment drawings and torque all terminations in accordance with the equipment manufacturers recommendations.
- E. Touch up all blemishes in factory finish on the equipment using the method recommended by the equipment manufacturer and using touch-up paint provided by the equipment manufacturer.

### **3.2 STARTUP AND COMMISSIONING**

- A. Provide startup and commissioning of the equipment by a factory authorized and factory trained field startup technician.
- B. Test functional operation of the load bank in both automatic and manual modes of operation from minimum to full rated load of the load bank.
- C. Repair and retest until equipment is fully functional as designed.
- D. Provide field startup report for Owner's records indicating the date and time and name of the technician who performed the equipment startup and commissioning services.

### **3.3 DEMONSTRATION AND OWNER TRAINING**

- A. Factory authorized and trained field service technician shall instruct the Owner's maintenance personnel on the operation of the load bank in both manual and automatic modes and on preventative maintenance and serving of all Owner serviceable components.

## **END OF SECTION 263236**

## **SECTION 263290 – GENERATOR CONNECTION CABINET**

### **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 SCOPE**

- A. The Contractor shall furnish and install a Generator Connection Cabinet as specified herein and as shown on the Drawings.

#### **1.3 RELATED SECTIONS**

- A. Section 260500 – Common Work Results for Electrical
- B. Section 260519 – Low-Voltage Electrical Power Conductors & Cables
- C. Section 260526 – Grounding and Bonding for Electrical Systems
- D. Section 260529 – Hangers and Support for Electrical Systems
- E. Section 260533.13 – Conduit for Electrical Systems
- F. Section 260553 – Identification for Electrical Systems
- G. Section 260573 – Protective Device Coordination Study and Arc Flash Risk Assessment
- H. Section 260583 – Wiring Connections
- I. Section 263213.13 – Diesel-Engine-Driven Generator Set

#### **1.4 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. Underwriters Laboratories, Inc (UL):
    - a. UL 50, Enclosures for Electrical Equipment, Non-Environmental Considerations
    - b. UL 1008 Supplement SB: Standard for Accessories, Transfer Switch
  - 2. National Electrical Manufacturers Association (NEMA):
    - a. NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum)

#### **1.5 QUALIFICATIONS**

- A. For the equipment specified herein, the Generator Connection Cabinet shall be of standard design and manufacture, and not a custom-built piece of equipment.
- B. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Designer, an acceptable list of

installations with similar equipment shall be provided demonstrating compliance with this requirement.

## **1.6 REGULATORY REQUIREMENTS**

- A. The Generator Connection Cabinet shall be UL listed and labeled as a complete assembly.

## **1.7 SUBMITTALS**

- A. Shop Drawings:

1. Product technical data:
  - a. Overall product dimensions: height, width, depth
  - b. Front and side elevation views
  - c. Foot/wall print
  - d. Line & load connection details
  - e. Conduit entry location(s)
  - f. Assembly ratings including
    - 1) Short-circuit rating
    - 2) Voltage
    - 3) Continuous current Amperage rating

## **1.8 DELIVERY, STORAGE, AND HANDLING**

- A. See Specification Section 260500 - Common Work Results for Electrical

## **1.9 WARRANTY**

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of Generator Connection Cabinet that fail in materials or workmanship within specified warranty period
1. Warranty Period: One (1) year from date of substantial completion of the project

## **PART 2 - PRODUCTS**

### **2.1 ACCEPTABLE MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Berthold Electric
  2. ESL Power Systems
  3. Trystar

### **2.2 GENERATOR CONNECTION CABINET**

- A. Ratings:
1. Voltage and amperage: 480Y/277V, 3-phase, 4-wire, 1600A

2. Short circuit current rating: 35kA
3. Do not order generator connection cabinet until the required short-circuit current ratings have been determined in accordance with Specification Section 260573 – Protective Device Coordination Study and Arc Flash Risk Assessment.

B. Construction:

1. Bus material: 1000A/in<sup>2</sup> silver-plated copper
2. Bus supported with UL Recognized Component insulators
3. Permanent bus connection:
  - a. Two-hole rectangular tongue, long-barrel compression lugs
  - b. Quantity: As required for the number of conductors indicated on the Drawings
4. Field (temporary) wiring connections:
  - a. Temporary Generator Connection: Color coded male 400 Amp Cooper Crouse-Hinds Cam-Loks  
Quantity: 1 connection per 400A
  - b. Resistive Load Bank Connection: Color coded female 400 Amp Cooper Crouse-Hinds Cam-Loks  
Quantity: 1 connection per 400A

C. Enclosure:

1. Wall mount with external mounting ears
2. NEMA 3R rated
3. Material: Aluminum or stainless steel
4. Finish: Bare metal
5. Lockable latches on Cam-Lok access door
6. Drip hood

D. Optional Features

1. Security cabinet: Cam-Loks mounted internally behind temporary cable pass-through openings to prevent unauthorized cable disconnection while in use
2. Cam-Lok Snap covers
  - a. Color-coded to match Cam-Loks
  - b. Spring activated to close when not connected
  - c. Thermoplastic covers and bodies
3. Phase rotation monitor
  - a. 480VAC, 3-phase, 60Hz
  - b. Analog monitoring relay
  - c. Repeatability accuracy: 1%
  - d. LED indicators for phase failure and phase sequence
  - e. Self-resetting

- f. Response time: 450ms maximum
  - g. Impulse resistance: 6kV
  - h. Operating temperature: -25°C to 60°C
  - i. Screw-type terminals for two (2) 20AWG to 14AWG solid or stranded conductors
  - j. Output relay: 3A @ 250VAC, 1A @ 24VDC, 0.2A @ 125VDC, 0.1A @ 250VDC
- 4. 4-point 20-amp terminal strip for auto-start and control wiring connections
  - 5. QTY (1) 125V, 20-amp GFCI protected duplex receptacle with aluminum, spring loaded weatherproof cover for temporary generator battery charger connection
  - 6. QTY (2) 125V, single-phase, 30-amp receptacles (NEMA L5-30R) with aluminum, spring loaded weatherproof cover for temporary generator jacket water heater connections

E. Standards: UL 1008 Supplement SB: Standard for Accessories, Transfer Switch

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install as indicated and in accordance with manufacturer's recommendations and instructions
- B. Connect as indicated in one-line diagram

#### **3.2 ARC FLASH HAZARD WARNING LABEL**

- A. Provide arc flash hazard warning label on exterior door of generator connection cabinet in accordance with Sections 260553 - Identification for Electrical Systems and 260573 – Protective Device Coordination Study and Arc Flash Risk Assessment.

**END OF SECTION 263290**



## **SECTION 263623 – AUTOMATIC TRANSFER SWITCHES, OPEN TRANSITION**

### **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 SCOPE**

- A. The Contractor shall furnish and install automatic open transition transfer switches (ATS) and automatic open transition transfer and bypass-isolation switches (ATS/BPS) as specified herein and as shown on the Drawings.
- B. Each ATS shall consist of a mechanically held open transition power transfer switch unit and a microprocessor controller, interconnected to provide a complete break-before-make automatic transfer operation.
- C. Each ATS/BPS shall consist of an open transition transfer switch and a two-way bypass/isolation switch.
- D. The ATS's and ATS/BPS's, generically referred to as ATS's throughout this document, shall be used to automatically transfer the building loads from the normal power source to the new emergency generator specified in Section 263213.13 – Diesel-Engine-Driven Generator Set upon a failure of the normal power source.
- E. Each ATS shall transfer its connected load by means of a break-before-make (open transition) switching operation that will result in a momentary loss of power during the transfer between the two power sources.

#### **1.3 RELATED SECTIONS**

- A. Division 3 – Concrete
- B. Section 260500 – Common Work Results for Electrical
- C. Section 260526 – Grounding and Bonding for Electrical Systems
- D. Section 260529 – Hangers and Supports for Electrical Systems
- E. Section 260533.13 – Conduit for Electrical Systems
- F. Section 260553 – Identification for Electrical Systems
- G. Section 260573 – Protective Device Coordination Study and Arc Flash Risk Assessment
- H. Section 260583 – Wiring Connections
- I. Section 260900 – Instrumentation and Control for Electrical Systems
- J. Section 263213.13 – Diesel-Engine-Driven Generator Set

## 1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's product data for automatic transfer switches and automatic transfer and bypass-isolation switches including, but not limited to, service voltages, number of phases, frequency, continuous current ratings, interrupting current ratings and enclosure type. Product data sheets shall indicate all standard features, special features and optional features that are to be provided. Provide data on microprocessor based ATS controller including programming options.
- B. Shop Drawings: Submit dimensioned plan view and elevation view outline drawings and internal physical diagrams for each type and size ATS.
- C. Wiring Diagrams: Submit wiring diagrams for all ATS's showing internal and external connections for power, control and communications wiring.
- D. Seismic Certification: Provide seismic free-standing qualification certificate for each complete ATS assembly.
- E. The manufacturer shall provide a notarized letter certifying compliance with all of the requirements of this specification including compliance with the specified codes and standards and withstand and closing ratings. The certification shall identify, by serial number(s), the equipment involved. No exceptions to the specifications, other than those stipulated at the time of the submittal, will be permitted to be included in the certification.
- F. The ATS submittals will not be approved until the required short-circuit current ratings have been determined in accordance with Specification Section 260573 – Protective Device Coordination Study and Arc Flash Risk Assessment.
- G. Submit Operation and Maintenance (O&M) Manuals in accordance with the General Conditions Section of these Specifications no later than ten (10) working days prior to the substantial completion inspection.
- H. O&M Manuals shall be conformed to “as-built” status by incorporating any and all changes made during the startup period.

## 1.5 REFERENCES

- A. All open transition automatic transfer switches and open transition automatic transfer and bypass-isolation switches shall be designed and manufactured according to the applicable provisions of the latest revision of the following codes and standards:
  - 1. NFPA 70 – National Electrical Code, including use in emergency and standby systems in accordance with Articles 700, 701, 702 and 517
  - 2. NFPA 99 – Health Care Facilities Code
  - 3. NFPA 101 – Life Safety Code
  - 4. NFPA 110 – Standard for Emergency and Standby Power Systems
  - 5. IEC 60947-6-1 – Low-Voltage Switchgear and Controlgear - Part 6-1: Multiple Function Equipment - Transfer Switching Equipment
  - 6. IEEE Standard 446 – IEEE Recommended Practice for Emergency and Standby Power Systems (Orange Book)

7. IEEE Standard 241 – IEEE Recommended Practice for Electric Power Systems in Commercial Buildings (Gray Book)
8. IEEE Standard 472 (ANSI C37.90A) – Ringing Wave Immunity
9. NEMA Standard ICS10 – AC Automatic Transfer Switches
10. UL 50 – Enclosures for Electrical Equipment
11. UL 508 – Industrial Control Equipment
12. UL 1008 – Standard for Transfer Switch Equipment
13. EN55022 Class B – (CISPR11): Conducted and Radiated Emissions
14. EN61000-4-2 (Level 4) – Electrostatic Discharge (ESD) Immunity Test
15. EN61000-4-3 (ENV50140) – Radiated Electromagnetic Field Immunity Test
16. EN61000-4-4 – Electrical Fast Transient (EFT)/Burst Immunity Test
17. EN61000-4-5 (IEEE C62.41) – Surge Transient Immunity Test
18. EN61000-4-6 (ENV50141) – Conducted Radio-Frequency (RF) Field Immunity Test
19. EN61000-4-11 – Voltage Dips and Interruption Immunity

## **1.6 QUALIFICATIONS**

- A. The manufacturer of the ATS assemblies shall have produced similar electrical equipment for a minimum of fifteen (15) years. When requested by the Designer, an acceptable list of a minimum of ten (10) installations with similar equipment shall be provided to demonstrate compliance with this requirement.
- B. The ATS manufacturer shall maintain a full parts and service center with 24/7/365 service availability within one hundred (100) miles of the project site and all service personnel shall be factory trained and certified.
- C. All ATS's and control modules/controllers shall be the product of the same manufacturer.
- D. As a precondition for approval, all automatic transfer switches, complete with accessories, shall be listed by Underwriters Laboratories, under Standard UL 1008 (automatic transfer switches) and approved for use on emergency systems. The ATS assembly shall be labeled by a Nationally Recognized Testing Laboratory (NRTL).
- E. Provide equipment that is IBC/CBC seismically qualified with seismic freestanding label.

## **1.7 DELIVERY, STORAGE AND HANDLING**

- A. Inspect equipment and report concealed damage to carrier within their required time period.
- B. Handle equipment carefully and in accordance with manufacturer's recommendations to avoid damage to internal components, enclosure, and finish.
- C. Store equipment in a clean, dry indoor environment. Maintain factory packaging until time of installation. Cover with heavy canvas or plastic to keep out dirt, water and construction debris. Heat enclosures to prevent condensation.

## 1.8 WARRANTY

- A. Manufacturer shall warrant equipment to be free from defects in materials and workmanship for a minimum period of one (1) year from date of substantial completion of the project in accordance with the General Conditions Section of these Specifications.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. Each ATS shall automatically transfer the assigned load (L) from the "Normal" (N) source to the "Emergency" (E) source upon a loss of normal source power and retransfer back again upon restoration of normal source power. The load shall be transferred in both directions in "open transition" mode (break-before-make).
- B. All ATS's shall be UL Listed in accordance with UL 1008 as follows:
1. Rated in amperes for total system transfer including control of motors, electric-discharge lamps, electric-heating and tungsten-filament lamp loads as referred to in Paragraph 38.18 of UL 1008.
  2. Units shall be rated based on all classes of loads; i.e., resistive, tungsten, ballast, and inductive loads and all switch sizes shall be suitable for 30% tungsten-filament load. Switches rated at 400 amperes or less shall be UL listed for 100% tungsten lamp loads.
  3. Overload and endurance at 480 volts AC per Tables 25.1, 25.2, 27.1 and 27.2 of UL 1008 when enclosed according to Paragraph 1.6
  4. Temperature rise tests after the overload and endurance tests to confirm the ability of the transfer switch to carry rated current within the allowable temperature limits
  5. No welding of contacts. Transfer switch must be electrically operable to alternate power source after the withstand current tests.
  6. Dielectric tests at 1960 volts RMS minimum after the withstand current test
- C. The transfer switches shall be supplied with a microprocessor-based control panel as specified herein.
- D. Each ATS assembly, as well as the means of fastening to the building and/or concrete floor below the concrete equipment pad, shall be capable of withstanding seismic loads. The International Building Code – 2021 Edition and ASCE 7-16 – Minimum Design Loads for Buildings and Other Structures shall be used as the design code with the specific environmental factors as stated below:
1. Earthquake Design Data:
    - a. Seismic Importance Factor:  $I = 1.5$
    - b. Risk Category: IV
    - c. Mapped Spectral Response Accelerations:  $S_s = 0.446$ ,  $S_1 = 0.160$
    - d. Site Class: D
    - e. Spectral Response Coefficients:  $SDS = 0.429$ ,  $SD1 = 0.243$
    - f. Seismic Design Category: D

- g. Component Amplification Factor:  $A_p = 2.5$
- h. Component Response Modification Factor:  $R_p = 2$
- i. Overstrength Factor:  $\Omega_o = 2$
- j. Analysis Procedure: Equivalent Lateral Force ASCE 7-16 Section 13.3

## 2.2 RATINGS

- A. Each ATS shall be rated for 100% continuous duty for all classes of inductive and non-inductive loads. The transfer switches shall be rated for 480 volts, 3-phase, 60 hertz, 3 pole or 4 pole, 4 wire. The ampere rating and number of switched poles for each ATS shall be as indicated on the Drawings.
- B. Each ATS shall be rated for the voltage and ampacity as shown on the Drawings and shall have 600-volt insulation on all parts in accordance with NEMA standards.
- C. The current rating shall be a 24-hour continuous rating when the switch is installed in an unventilated enclosure and shall conform to NEMA temperature rise standards.
- D. The thermal capacity of the main contacts shall not be less than 20 times the continuous duty rating for a minimum of 3 electrical cycles as established by certified test data.
- E. The minimum UL listed Withstand and Closing Ratings shall be 50,000 RMS symmetrical amperes at 480 volts, 60 Hz for 3 cycles with the type of upstream overcurrent protection shown on the Drawings.
- F. All transfer switches shall be "fully rated." A "series rated" switch is not acceptable.
- G. Do not order automatic transfer switches until the required short-circuit current ratings have been determined in accordance with Specification Section 260573 – Protective Device Coordination Study and Arc Flash Risk Assessment.

## 2.3 MICROPROCESSOR BASED CONTROLLER

- A. Each transfer switch shall be equipped with a microprocessor-based control panel. The control panel shall perform the operational and display functions of the transfer switch. The display functions of the control panel shall include ATS position and source availability.
- B. The control panel shall be provided with menu driven display screens for transfer switch monitoring, control and field changeable functions and settings.
- C. The controller shall direct the operation of the transfer switch. The controller's sensing and logic shall be controlled by a built-in microprocessor for maximum reliability, minimum maintenance, inherent serial communications capability, and the ability to communicate via an Ethernet connection through an internally mounted communications module.
- D. A single controller shall provide single and three phase capability for maximum application flexibility and minimal spare part requirements. Voltage sensing shall be true RMS type and shall be accurate to  $\pm 1\%$  of nominal voltage. Frequency sensing shall be accurate to  $\pm 0.2\%$ . Time delay settings shall be accurate to  $\pm 0.5\%$  of the full-scale

value of the time delay. The panel shall be capable of operating over a temperature range of -20°C to 60°C and a storage temperature from -55°C to 85°C.

- E. The controller shall be enclosed with a protective cover and be mounted separate from the transfer switch unit for safety and ease of maintenance. The digital display shall be accessible without opening the enclosure door.
- F. Sensing and control logic shall be provided on multi-layer printed circuit boards that are opto-isolated from electrical noise.
- G. Interfacing relays shall be industrial grade plug-in type with dust covers.
- H. A common terminal block shall be provided for all field wiring connections.
- I. The controller shall be connected to the transfer switch by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the controller to be disconnected from the transfer switch for routine maintenance.
- J. The controller shall meet or exceed the requirements for Electromagnetic Compatibility (EMC) as follows:
  - 1. IEC 60947 – 6 – 1 Multiple Function Equipment Transfer Switching Equipment
    - a. IEC 61000-4 Testing and Measurement Techniques – Overview
    - b. IEC 61000-4-2 Electrostatic Discharge Immunity
    - c. IEC 61000-4-3 Radiated RF Field Immunity
    - d. IEC 61000-4-4 Electrical Fast Transient/Burst Immunity
    - e. IEC 61000-4-5 Surge Immunity
    - f. IEC 61000-4-6 Conducted RF Immunity
  - 2. CISPR 11 – Conducted RF Emissions and Radiated RF Emissions
- K. Controller Display and Keypad
  - 1. A backlit four-line, 20-character LCD display and keypad shall be an integral part of the controller for continuous viewing all available data and setting desired operational parameters. Operational parameters shall also be available for viewing and limited control through the serial communications input port. The following parameters shall only be adjustable via DIP switches on the controller.
    - a. Nominal line voltage and frequency
    - b. Single or three phase sensing
    - c. Transfer operating mode configuration, (open transition or delayed transition)
  - 2. All instructions and controller settings shall be easily accessible, readable, and accomplished without the use of codes, calculations, or instruction manuals.
  - 3. The programming functions shall be pass code protected.
  - 4. Provide touch pad test switch with Fast Test/Load/No Load positions to simulate a normal source failure.

- L. The following features shall be built-in to the controller, but shall be capable of being activated through keypad programming or the serial communications port when required by the User:
1. Provide the ability to select “commit/no commit to transfer” to determine whether the load should be transferred to the emergency generator if the normal source restores before the generator is ready to accept the load.
  2. *In-Phase Monitor*: An in-phase monitor shall be provided in the controller to control transfer so that motor load inrush currents do not exceed normal starting currents and shall not require external control of power sources. The in-phase monitor shall be specifically designed for and be the product of the ATS manufacturer.
  3. The controller shall be capable of accepting a normally open contact that will allow the transfer switch to function in a non-automatic mode using an external control device.
  4. *Engine Exerciser*: The controller shall provide an internal load/no-load engine exerciser. The engine exerciser shall allow the user to program up to seven different exercise routines. For each routine, the user shall be able to:
    - a. Enable or disable the routine
    - b. Enable or disable transfer of the load during routine
    - c. Set the start time; time of day, day of the week, week of the month (1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup>, alternate or every)
    - d. Set the duration of the run

At the end of the specified duration the switch shall transfer the load back to normal and run the generator for the specified cool down period. A 10-year life battery that supplies power to the real time clock in the event of a power loss will maintain all time and date information.
  5. *Non-Automatic Mode*: Terminals shall be provided for a remote contact which opens to signal the ATS to transfer to emergency and for remote contacts which open to inhibit transfer to emergency and/or retransfer to normal. Both of these inhibit signals can be activated through the keypad or serial communications port.
  6. *System Status*: The controller LCD display shall include a “System Status” screen which shall be readily accessible from any point in the menu by depressing the “ESC” key a maximum of two times. This screen shall display a clear description of the active operating sequence and switch position. For example:

Normal Failed  
Load on Normal  
TD Normal to Emerg  
2min15s

Controllers that require multiple screens to determine system status or display “coded” system status messages, which must be explained by references in the operator’s manual, are not permissible.
  7. *Self-Diagnostics*: The controller shall contain a diagnostic screen for the purpose of detecting system errors. This screen shall provide information on the status input signals to the controller which may be preventing load transfer commands from being completed.

8. Data Logging: The controller shall have the ability to log data and to maintain the last 99 events, even in the event of total power loss. The following events shall be time and date stamped and maintained in a non-volatile memory:
  - a. Event Logging
    - 1) Date and time and reason for transfer normal to emergency
    - 2) Date and time and reason for transfer emergency to normal
    - 3) Date and time and reason for engine start
    - 4) Date and time engine stopped
    - 5) Date and time emergency source available
    - 6) Date and time emergency source not available
  - b. Statistical Data
    - 1) Total number of transfers
    - 2) Total number of transfers due to source failure
    - 3) Total number of days controller is energized
    - 4) Total number of hours both normal and emergency sources are available
    - 5) Date and time emergency source available

## 2.4 VOLTAGE, FREQUENCY AND PHASE ROTATION SENSING

- A. Voltage and frequency on both the normal and emergency sources (as noted below) shall be continuously monitored, with the following pickup, dropout, and trip settings capabilities (values shown as % of nominal unless otherwise specified).

| <u>Parameter</u>  | <u>Sources</u> | <u>Dropout/Trip</u> | <u>Pickup/Reset</u> |
|-------------------|----------------|---------------------|---------------------|
| Undervoltage      | N & E, 3Φ      | 70 to 98%           | 85 to 100%          |
| Overvoltage       | N & E, 3Φ      | 102 to 115%         | 2% below trip       |
| Underfrequency    | N & E          | 85 to 98%           | 90 to 100%          |
| Overfrequency     | N & E          | 102 to 110%         | 2% below trip       |
| Voltage Unbalance | N&E            | 5 to 20%            | 1% below dropout    |

- B. Repetitive accuracy of all settings shall be within +/-0.5 over an operating temperature of -20°C to 60°C.
- C. Voltage and frequency settings shall be field adjustable in 1% increments either locally with the display and keypad or remotely via serial communications port access.
- D. The controller shall be capable, via the keypad or through the serial communications port, of sensing the phase rotation of both the normal and emergency sources. The source shall be considered unacceptable if the phase rotation is not the preferred rotation selected (ABC or CBA).
- E. Source status screens shall be provided for both normal and emergency to provide digital readout of voltage on all three phases, frequency and phase rotation. Single-phase sensing on both the normal and the emergency sources shall be provided.



- F. The controller shall include a user selectable algorithm to inhibit retransfer to the normal (utility) source upon detection of a single phasing condition until a dedicated timer expires, the alternate source fails, or the normal source fails completely and is restored during this time delay period. The time delays associated with this feature shall be adjustable by the user through the controller keypad and LCD display.

## **2.5 TIME DELAYS**

- A. A time delay shall be provided to override momentary normal source outages and delay all transfer and engine starting signals, adjustable 0 to 6 seconds. It shall be possible to bypass the time delay from the controller user interface. Initial setting for this time delay shall be 2 seconds. Capability shall be provided to extend the time delay to 60 minutes by means of an external 24 VDC power supply.
- B. A time delay shall be provided on transfer from normal to emergency, adjustable from 0 to 60 minutes, for controlled timing of transfer of loads to emergency. It shall be possible to bypass the time delay from the controller user interface. Initial setting for this time delay shall be 1 seconds.
- C. A generator stabilization time delay shall be provided after transfer to emergency adjustable 0 or 4 seconds. Initial setting for this time delay shall be 1 second.
- D. Two (2) time delay modes shall be provided on re-transfer to normal. One time delay shall be for actual normal power failures and the other shall be for the test mode function. The time delays shall be independently adjustable from 0 to 60 minutes. If the emergency source fails during the retransfer time delay, the transfer switch controls shall automatically bypass the time delay and immediately retransfer to the normal position. Initial setting for this time delay shall be 10 minutes.
- E. Time delay on transfer in either direction in the center-off position, programmable 0-2 minutes, factory set at 5 seconds.
- F. A cooldown time delay shall be provided on shutdown of engine generator, Adjustable 0 to 60 minutes. Initial setting for this time delay shall be 0 if engine cooldown timer is included in the generator control panel. Otherwise, the initial setting for this time delay shall be 10 minutes.
- G. A time delay activated output signal shall also be provided to drive an external relay(s) for selective load disconnect control. The controller shall have the ability to activate an adjustable 0 to 5 minutes time delay in any of the following modes:
  - 1. Prior to transfer only
  - 2. Prior to and after transfer
  - 3. Normal to emergency only
  - 4. Emergency to normal only
  - 5. Normal to emergency and emergency to normal
  - 6. All transfer conditions or only when both sources are available
- H. If the alternate source is not accepted within the configured Failure to Accept time delay, the common alert indication shall become active.

- I. The controller shall also include the following built-in time delay for delayed transition operation:
  - 1. A time delay for the load disconnect position for delayed transition operation adjustable 0 to 5 minutes. Initial setting for this time delay shall be 0.
- J. All adjustable time delays shall be field adjustable in 1 second increments using the LCD display and keypad or with a remote device connected to the serial communications port. The time delay value displayed on the LCD display or remote device shall be the remaining time until the next event occurs.

## **2.6 CONSTRUCTION AND PERFORMANCE**

- A. Each automatic transfer switch shall be an electrically operated, mechanically held, double-throw switch having a uni-directional drive mechanism. Operating coils shall be momentarily energized from the source to which the load is being transferred. Operating coils shall have coil clearing contacts.
- B. All transfer switch sizes shall use only one type of main operator for ease of maintenance and commonality of parts.
- C. The switch shall be positively locked and unaffected by voltage variations or momentary outages so that contact pressure is maintained at a constant value and temperature rise at the contacts is minimized for maximum reliability and operating life.
- D. The contact structure shall consist of a main current carrying contact which is a silver alloy with a minimum of 50% silver content. Switches rated 800A and above shall have segmented, blow-on construction for high withstand and close-one capability and shall be protected by separate arcing contacts on all sizes.
- E. Inspection of all contacts (movable and stationary) shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors. Switches rated 800A and higher shall have front removable and replaceable contacts. All stationary and moveable contacts shall be replaceable without removing power conductors or bus bars.
- F. Switches composed of molded case breakers, contactors or components thereof will not be acceptable. Main operators which include overcurrent disconnect devices are not acceptable.
- G. The switch shall be mechanically interlocked to ensure only one of two possible positions, normal or emergency.
- H. The contact transfer time in either direction shall not exceed one-sixth (1/6) of a second.
- I. The transfer switch manufacturer shall submit test data for each size switch, showing it can withstand fault currents of the magnitude and the duration necessary to maintain system integrity. Minimum UL listed withstand and closing ratings shall be 50,000 RMS symmetrical amperes at 480 volts, 60 Hz for 3 cycles with the type of upstream overcurrent protection shown on the Drawings.
- J. A dielectric test at the conclusion of the withstand and closing tests shall be performed.

- K. The transfer switch manufacturer shall certify arc interrupting capabilities for 50 cycles of operation between a normal and emergency source that are 120 degrees out of phase at 480 volts, 600% of rated current at 0.50 power factor. This certification is to ensure that there will be no current flow between the two isolated sources during switching.
- L. Temperature rise tests in accordance with UL 1008 shall have been conducted after the overload and endurance tests to confirm the ability of the units to carry their rated currents within the allowable temperature limits.
- M. All relays shall be continuous duty industrial type with wiping contacts. Customer interface contacts shall be rated 10 amperes minimum. Coils, relays, timers and accessories shall be front accessible. The control panel and power section shall be interconnected with a harness and keyed disconnect plugs for maintenance.
- N. All coils, relays, timers, and accessories shall be readily front accessible.
- O. Main and arcing contacts shall be visible without major disassembly to facilitate inspection and maintenance.
- P. A manual handle shall be provided for maintenance purposes with the switch de-energized. The handle shall permit the operator to stop the contacts at any point throughout the entire travel to properly inspect and service the contacts when required.
- Q. An operator disconnect switch shall be provided to defeat automatic operation during maintenance, inspection or manual operation.
- R. A means shall be provided to manually operate the transfer switch in the event of switch failure.
- S. Automatic transfer switches must be equipped with a solenoid protection scheme that removes any attempts of operating the solenoids after (3) consecutive trials until manual intervention by an operator.
- T. Each transfer switch shall be mounted in a NEMA 1 enclosure with hinged, lockable front access doors.
  - 1. Due to limited space in the main electrical room, the maximum allowable depth and width of the enclosure for “ATS-2”, “ATS-3” and “ATS-4” shall be:
    - a. ATS-2: 2 feet, 0 inches wide x 1 foot, 6 inches deep
    - b. ATS-3: 2 feet, 0 inches wide x 1 foot, 6 inches deep
    - c. ATS-4: 2 feet, 10 inches wide x 2 feet, 4 inches deep
  - 2. Due to limited space in the main mechanical room, the maximum allowable width and depth of the enclosure for “ATS-6” through “ATS-11” shall be:
    - a. ATS-6: 2 feet, 0 inches wide x 1 foot, 6 inches deep
    - b. ATS-7: 2 feet, 10 inches wide x 1 foot, 8 inches deep
    - c. ATS-8: 2 feet, 0 inches wide x 1 foot, 6 inches deep
    - d. ATS-9: 2 feet, 0 inches wide x 1 foot, 6 inches deep
    - e. ATS-10: 2 feet, 0 inches wide x 1 foot, 6 inches deep
    - f. ATS-11: 2 feet, 0 inches wide x 1 foot, 6 inches deep

- U. Normal, emergency and load terminal arrangement/location within "ATS-2" and "ATS-3" shall match the configuration of the existing ATS that each of these three new ATSs is to replace.
- V. ATS enclosures shall be properly cleaned and prepared for painting and shall have, as a minimum, a baked-on finish consisting of one coat of rust-inhibiting primer and a finish coat, having a minimum dry film thickness of 3 mils of ANSI-61 light gray or ANSI-49 medium gray enamel.

## **2.7 BYPASS-ISOLATION SWITCHES**

- A. A two-way bypass-isolation switch shall provide manual bypass of the load to either source and permit isolation of the automatic transfer switch from all source and load power conductors. All main contacts shall be manually driven.
- B. Power interconnections shall be silver-plated copper bus bar. The only field installed power connections shall be at the service and load terminals of the bypass-isolation switch. All control interwiring shall be provided with disconnect plugs.
- C. Separate bypass and isolation handles shall be utilized to provide clear distinction between the functions. Handles shall be permanently affixed and operable without opening the enclosure door. Designs requiring insertion of loose operating handles or opening of the enclosure door to operate are not acceptable.
- D. Bypass to the load-carrying source shall be accomplished with no interruption of power to the load (make before break contacts). Designs which disconnect the load when bypassing are not acceptable. The bypass handle shall have three operating modes: "Bypass to Normal," "Automatic," and "Bypass to Emergency." The operating speed of the bypass contacts shall be the same as the associated transfer switch and shall be independent of the speed at which the manual handle is operated. In the "Automatic" mode, the bypass contacts shall be out of the power circuit so that they will not be subjected to fault currents to which the system may be subjected.
- E. The isolation handle shall provide three operating modes: "Closed," "Test," and "Open." The "Test" mode shall permit testing of the entire emergency power system, including the automatic transfer switches with no interruption of power to the load. The "Open" mode shall completely isolate the automatic transfer switch from all source and load power conductors. When in the "Open" mode, it shall be possible to completely withdraw the automatic transfer switch for inspection or maintenance to conform to code requirements without removal of power conductors or the use of any tools.
- F. When the isolation switch is in the "Test" or "Open" mode, the bypass switch shall function as a manual transfer switch.
- G. Designs requiring operation of key interlocks for bypass isolation or ATSs which cannot be completely withdrawn when isolated are not acceptable.
- H. Provide auxiliary contacts to indicate all possible switch positions.

## **2.8 SEQUENCE OF OPERATION**

- A. Each ATS shall incorporate adjustable three phase under and over-voltage and three phase under and over-frequency sensing on the normal source.

- B. When the voltage on any phase of the normal source is reduced to 85% of rated voltage for 10 seconds (programmable), a pilot contact shall close to initiate starting of the generator.
- C. Each ATS shall incorporate adjustable three phase under and over-voltage and three phase under and over-frequency sensing on the emergency source.
- D. When the generator is delivering not less than 90% of rated voltage and 95% of rated frequency, the load shall be transferred to the emergency source after an adjustable time delay. During test or other source to source transfer, 95% voltage and frequency, phase rotation and angle shall be verified.
- E. When the normal source has been restored to not less than 95% and not more than 105% of nominal voltage on all phases, proper phase rotation is verified, and after a time delay of 0 to 30 minutes (adjustable), the load shall be transferred to the normal source in an open transition operation. The generator shall run unloaded for 15 minutes (adjustable) and then shut down. The generator shall be ready for automatic operation upon the next failure of the normal source.
- F. If the engine generator should fail while carrying the load, open transition retransfer to the normal source shall be made instantaneously upon restoration of proper voltage (90%) on the normal source.

## 2.9 ACCESSORIES

- A. Each automatic transfer switch shall include the following items as a minimum.
  - 1. Voltage sensitive relays for full voltage protection
  - 2. Two (2) auxiliary 120V, 10A, form "C" contacts which change state depending on the voltage source used
  - 3. 2PDT auxiliary 120V, 10A contacts which change state when the emergency source voltage is present at the transfer switch terminals
  - 4. 2PDT auxiliary 120V, 10A contacts which change state when the normal source voltage is present at the transfer switch terminals
  - 5. One (1) auxiliary 120V, 10A form "C" contact which changes state on "normal" line failure
  - 6. A timed auxiliary contact (1 N.C.) adjustable 0-60 seconds shall be provided to allow motor loads to be disconnected prior to transfer in either direction
  - 7. Pilot lights shall be provided on the exterior side of the enclosure door and shall be energized by controller outputs to indicate the following:
    - a. Green to indicate switch is in NORMAL power position
    - b. Red to indicate switch is in the EMERGENCY power position
    - c. White to indicate NORMAL power source is available
    - d. Amber to indicate EMERGENCY power source is available
  - 8. Pilot lights shall be round or square, panel mounted, NEMA Type 12, 16 mm minimum size, 120 volts AC, 60 hertz, using high intensity LED lamps. Lamps shall be replaceable by removal of the color cap. "Neon" type lamps are not acceptable.

9. A lamp test push button shall be provided on the exterior side of the enclosure door, which shall test all pilot lights simultaneously. Push-to-test pilot lights may be provided in lieu of a single lamp test push button.
10. Each pilot light, push button, or selector switch shall be identified with the device manufacturer's engraved collar legend nameplate having the wording as shown on the Drawings or as specified herein.
11. Transfer Switch Test Switch: A two-position key operated selector switch having maintained NORMAL or AUTO position and maintained TEST position, with nameplates indicating TEST and NORMAL or AUTO mounted on the exterior side of the enclosure door.
  - a. The "normal" or "auto" mode shall be for placing the transfer switch control circuitry in normal operation as specified herein.
  - b. The "test" mode shall be for manual simulation of "normal" power source failure or outage (as herein specified in Article 2.8 of this Section).
  - c. Switching the selector switch back to the "normal" or "auto" mode position from the "test" mode position shall manually simulate the return of the "normal" power source and shall activate all phases of operation associated therewith.
12. Engine-Generator Set Starting Contact: A SPDT contact, rated 5 amps at 30 VDC, shall be provided for a low-voltage engine start signal. The start signal shall prevent dry cranking of the engine by requiring the generator set to reach proper output and run for the duration of the cool down setting, regardless of whether the normal source restores before the load is transferred.
13. Provide a momentary pushbutton to bypass the time delays on transfer and retransfer and programmable commit/no commit control logic.
14. Provide terminals for remote test/peak shave operation and transfer inhibit to the emergency source.
15. External DC Power Supply Provisions: Provide provisions for connection of an external 24 VDC power supply to allow the LCD and the door mounted control indicators to remain functional when both power sources are dead.

## 2.10 COMMUNICATIONS

- A. Provide all hardware and software required for Modbus TCP/IP or Modbus RTU (to be determined at time of shop drawing submittal review) communications between all nine (9) new ATSS and the Owner's existing Niagara building automation system (BAS). Coordinate with Specification Section 260900 – Instrumentation and Control for Electrical Systems requirements.
- B. All communications hardware shall be UL 1008 listed and labeled.
- C. Include control power transformer or power supply as required to power the communications hardware.
- D. Hardware shall be capable of operating in ambient temperatures from -4°F to 140°F.
- E. Provide real-time monitoring and data logging of the power source status and the switch position of each ATS, including the maintenance bypass switch position if applicable.

- F. Provide pick-ups, drop-outs, time delays, engine exerciser schedule and feature settings for each ATS.
- G. Provide NFPA test and utility outage information to meet NFPA and Joint Commission compliance requirements.
- H. The communications module shall include the following features:
  - 1. Email notifications and SNMP traps of selectable events and alarms may be sent to a mobile device or PC.
  - 2. Modbus TCP/IP, SNMP, HTTP, SMTP open protocols shall be simultaneously supported.
  - 3. Web app interface requiring user credentials to monitor and control the transfer switch supporting modern smart phones, tablets and PC browsers. User shall be able to view the dynamic on-line, ATS controls status, alarms, metering, event logging as well as settings.
  - 4. Secure access shall be provided by requiring credentials for a minimum of 3 user privilege levels to the web app.
    - a. Monitor (view only)
    - b. Control (view and control)
    - c. Administrator (view, control and change settings)
  - 5. 128-bit AES encryption standard shall be supported for all means of connectivity.
  - 6. Allow for the initiating of transfers, retransfers, bypassing of active timers and activating/deactivating of engine start signal shall be available over the embedded webpage and to the transfer switch vendor's monitoring equipment.
  - 7. An event log displaying a minimum of three hundred (300) events shall be viewable and printable from the embedded webpages and accessible from supported open protocols.
  - 8. Four (4) 100Mbps Ethernet copper RJ-45 ports, two (2) serial ports, termination dipswitches and LEDs for diagnostics.
  - 9. DIN rail mountable.

## **2.11 NAMEPLATES**

- A. All devices mounted on the transfer switch enclosure door, as well as individual items mounted inside the enclosure, shall be provided with a nameplate to show the identification and/or function of the device or item.
- B. All nameplates shall be engraved laminated plastic in accordance with Section 260553 – Identification for Electrical Systems. Unless otherwise indicated, all nameplates shall have 1/4-inch high characters.

## **2.12 APPROVED MANUFACTURERS**

- A. Open-transition automatic transfer and open-transition automatic transfer with bypass-isolation switches shall be as manufactured by:
  - 1. Automatic Switch Co., 7000 Series

2. Russelectric Inc., RTS-03 Series
  3. ABB-GE Zenith Controls, Inc., ZTS Series
- B. The basis of design for the open transition automatic transfer switches and open transition automatic transfer with bypass-isolation switches is the ASCO 7000 Series. Should the Contractor choose to include one of the approved equal manufacturers, he will be responsible for any additional costs resulting from physical changes and/or required accessories to make the equipment work with the existing conditions at the Facility.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. The Contractor shall verify NEC clearances as indicated on the Drawings prior to installation. Working space and clearances shall be in accordance with NEC Article 110. Verify UL labeling of the assembly prior to installation.
- B. The Contractor shall follow the installation instructions supplied by the manufacturer.
- C. Rig each ATS assembly into final location and install on level, 3-1/2" high concrete housekeeping pad, with 1" chamfered top edge, per Section 260500 – Common Work Results for Electrical. The pad shall be 2" larger than the ATS enclosure in the front and on both sides as shown on the Drawings and in accordance with Section 260500 – 2.3 – Equipment Pads and Anchor Bolts.
- D. Each ATS shall be bolted to the concrete floor using expansion anchor bolts meeting the requirements of Section 260529 – Hangers and Supports for Electrical Equipment. Anchor bolt size, quantity and placement shall be as indicated in the ATS manufacturer's installation instructions for seismic freestanding certification. Anchor bolts shall extend through the concrete housekeeping pad to provide the required embedment in the concrete floor below the housekeeping pad. As a minimum, provide one anchor bolt at each corner with 6" minimum embedment into the concrete floor below the housekeeping pad.
- E. All conduits which terminate at the top of an ATS shall be terminated in insulated throat, grounding type, liquid tight rigid conduit hubs in accordance with Section 260533.13 – Conduit for Electrical Systems. Grounding lug on the lock nut of each conduit hub shall be connected to the ATS interior ground bus bar in accordance with Section 260526 – Grounding and Bonding for Electrical Systems.
- F. Where a new ATS is to be installed in the same location as an existing ATS, and the existing conductors are indicated to remain in place, extend existing conductors to the appropriate terminals on the new switch if/as required utilizing in-line, long-barrel compression connectors with cold shrink insulating tubes in accordance with Section 260583 – Wiring Connections.
- G. Torque all bolted connections made in the field in accordance with manufacturer's published values using calibrated torque wrench.

### **3.2 ARC FLASH HAZARD WARNING LABEL**

- A. Provide arc flash hazard warning label on exterior door of all automatic transfer switches in accordance with Sections 260553 - Identification for Electrical Systems and 260573 – Protective Device Coordination Study and Arc Flash Risk Assessment.



### **3.3 TESTS**

- A. Each transfer switch, complete with all timers, relays, and accessories shall be listed by Underwriters' Laboratories, Inc. (UL), and shall have been tested, approved, and rated for total system load according to UL Standard 1008, including short circuit test.
- B. The transfer switch manufacturer shall submit test data for each switch, verifying that the switch can withstand, without damage, fault currents of the magnitude and the duration necessary to maintain the system integrity.
- C. All production units shall be subjected to the following factory tests:
  - 1. The complete transfer switch shall be tested to ensure proper operation.
  - 2. The transfer switch shall be subjected to a dielectric strength test per NEMA Standard ICS1-109.21.
- D. The normal and emergency power supplying each automatic transfer switch shall be tested for comparable phase relationships.
- E. Each automatic transfer switch shall have its normal power interrupted in order to ensure fully automatic shifting of power from its normal source to emergency power.
- F. Each transfer switch shall be tested for operation below 85% rated voltage. Also test the contacts and signal that activates the diesel-electric generator set and confirm the closing of the emergency contacts when the generator is up to 90% rated voltage.
- G. All test switches and pilot lights shall be tested for correct operation and sequence.
- H. Verify proper operation of the TCP/IP or BACnet IP communications interface with the Owner's existing Niagara BAS. Coordinate with the BAS Contractor.
- I. All emergency power system tests shall be tested in the presence of and approved by the Construction Representative.

### **3.4 TRAINING**

- A. Provide two (2) hours of on-site training by factory trained field service technician to instruct the Owner's personnel in the proper operation and routine maintenance of the equipment. Review operation and maintenance manuals, parts manuals and emergency service procedures. This shall be done after completion of the acceptance testing. Training session shall be video recorded, and two (2) copies of the video shall be provided to the Owner on DVD disc or USB thumb drive.

**END OF SECTION 263623**

## **SECTION 263623.13 – AUTOMATIC TRANSFER SWITCHES, CLOSED TRANSITION**

### **ALTERNATE BID NO. 1**

#### **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 SCOPE**

- A. The Contractor shall furnish and install automatic closed transition transfer switches (CTATS) and automatic closed transition transfer and bypass-isolation switches (CTATS/BPS) as specified herein and as shown on the Drawings.
- B. Each CTATS shall consist of a mechanically held closed transition power transfer switch unit and a microprocessor controller, interconnected to provide a complete make-before-break automatic transfer operation.
- C. Each CTATS/BPS shall consist of a closed transition transfer switch and a two-way bypass/isolation switch.
- D. The CTATS's and CTATS/BPS's, generically referred to as ATS's throughout this document, shall be used to automatically transfer the building loads from the normal power source to the new emergency generator specified in Section 263213.13 – Diesel-Engine-Driven Generator Set upon a failure of the normal power source.
- E. Each ATS shall transfer its connected load without interruption (closed transition) by momentarily connecting both sources of power only when both sources are present and acceptable. The maximum interconnection time shall be 100 milliseconds. Each CTATS shall operate as a conventional break-before-make (open transition) switch when the power source serving the load fails.

##### **1.3 RELATED SECTIONS**

- A. Division 3 – Concrete
- B. Section 260500 – Common Work Results for Electrical
- C. Section 260526 – Grounding and Bonding for Electrical Systems
- D. Section 260529 – Hangers and Supports for Electrical Systems
- E. Section 260533.13 – Conduit for Electrical Systems
- F. Section 260553 – Identification for Electrical Systems
- G. Section 260573 – Protective Device Coordination Study and Arc Flash Risk Analysis
- H. Section 260583 – Wiring Connections
- I. Section 260900 – Instrumentation and Control for Electrical Systems

Change in Scope, Re-Bid: Replace Emergency Generator, Infrastructure  
St. Louis Forensic Treatment Center - South, St. Louis, Missouri

M1908-01

J. Section 263213.13 – Diesel-Engine-Driven Generator Set

## 1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's product data for automatic transfer switches and automatic transfer and bypass-isolation switches including, but not limited to, service voltages, number of phases, frequency, continuous current ratings, interrupting current ratings and enclosure type. Product data sheets shall indicate all standard features, special features and optional features that are to be provided. Provide data on microprocessor based ATS controller including programming options.
- B. Shop Drawings: Submit dimensioned plan view and elevation view outline drawings and internal physical diagrams for each type and size ATS.
- C. Wiring Diagrams: Submit wiring diagrams for all ATS's showing internal and external connections for power, control and communications wiring.
- D. Seismic Certification: Provide seismic free-standing qualification certificate for each complete ATS assembly.
- E. The manufacturer shall provide a notarized letter certifying compliance with all of the requirements of this specification including compliance with the specified codes and standards and withstand and closing ratings. The certification shall identify, by serial number(s), the equipment involved. No exceptions to the specifications, other than those stipulated at the time of the submittal, will be permitted to be included in the certification.
- F. The ATS submittals will not be approved until the required short-circuit current ratings have been determined in accordance with Specification Section 260573 – Protective Device Coordination Study and Arc Flash Risk Assessment.
- G. The ATS submittals will be submitted to the local utility company, Ameren Missouri, for their approval before a release for manufacturing will be granted.
- H. Submit Operation and Maintenance (O&M) Manuals in accordance with the General Conditions Section of these Specifications no later than ten (10) working days prior to the substantial completion inspection.
- I. O&M Manuals shall be conformed to "as-built" status by incorporating any and all changes made during the startup period.

## 1.5 REFERENCES

- A. All closed-transition automatic transfer and bypass-isolation switches designed and manufactured according to the applicable provisions of the latest revision of the following codes and standards:
  - 1. NFPA 70 – National Electrical Code, including use in emergency and standby systems in accordance with Articles 700, 701, 702 and 708
  - 2. NFPA 99 – Health Care Facilities Code
  - 3. NFPA 101 – Life Safety Code
  - 4. NFPA 110 – Standard for Emergency and Standby Power Systems

5. IEC 60947-6-1 – Low-Voltage Switchgear and Controlgear - Part 6-1: Multiple Function Equipment - Transfer Switching Equipment
6. IEEE Standard 446 – IEEE Recommended Practice for Emergency and Standby Power Systems (Orange Book)
7. IEEE Standard 241 – IEEE Recommended Practice for Electric Power Systems in Commercial Buildings (Gray Book)
8. IEEE Standard 472 (ANSI C37.90A) – Ringing Wave Immunity
9. NEMA Standard ICS10 – AC Automatic Transfer Switches
10. UL 50 – Enclosures for Electrical Equipment
11. UL 508 – Industrial Control Equipment
12. UL 1008 – Standard for Transfer Switch Equipment
13. EN55022 Class B – (CISPR11): Conducted and Radiated Emissions
14. EN61000-4-2 (Level 4) – Electrostatic Discharge (ESD) Immunity Test
15. EN61000-4-3 (ENV50140) – Radiated Electromagnetic Field Immunity Test
16. EN61000-4-4 – Electrical Fast Transient (EFT)/Burst Immunity Test
17. EN61000-4-5 (IEEE C62.41) – Surge Transient Immunity Test
18. EN61000-4-6 (ENV50141) – Conducted Radio-Frequency (RF) Field Immunity Test
19. EN61000-4-11 – Voltage Dips and Interruption Immunity

## **1.6 QUALIFICATIONS**

- A. The manufacturer of the ATS assemblies shall have produced similar electrical equipment for a minimum of fifteen (15) years. When requested by the Designer, an acceptable list of a minimum of ten (10) installations with similar equipment shall be provided to demonstrate compliance with this requirement.
- B. The ATS manufacturer shall maintain a full parts and service center with 24/7/365 service availability within one hundred (100) miles of the project site and all service personnel shall be factory trained and certified
- C. All ATS's and control modules/controllers shall be the product of the same manufacturer.
- D. As a precondition for approval, all automatic transfer switches, complete with accessories, shall be listed by Underwriters Laboratories, under Standard UL 1008 (automatic transfer switches) and approved for use on emergency systems. The ATS assembly shall be labeled by a Nationally Recognized Testing Laboratory (NRTL).
- E. Provide equipment that is IBC/CBC seismically qualified with seismic freestanding label.

## **1.7 DELIVERY, STORAGE AND HANDLING**

- A. Inspect equipment and report concealed damage to carrier within their required time period.
- B. Handle equipment carefully and in accordance with manufacturer's recommendations to avoid damage to internal components, enclosure, and finish.

- C. Store equipment in a clean, dry indoor environment. Maintain factory packaging until time of installation. Cover with heavy canvas or plastic to keep out dirt, water and construction debris. Heat enclosures to prevent condensation.

## **1.8 WARRANTY**

- A. Manufacturer shall warrant equipment to be free from defects in materials and workmanship for a minimum period of one (1) year from date of substantial completion of the project.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- A. Each ATS shall automatically transfer the assigned load (L) from the "Normal" (N) source to the "Emergency" (E) source upon a loss of normal source power (open transition), and retransfer back again upon restoration of normal source power (closed transition).
- B. All ATS's shall be UL Listed in accordance with UL 1008 as follows:
  - 1. Rated in amperes for total system transfer including control of motors, electric-discharge lamps, electric-heating and tungsten-filament lamp loads as referred to in Paragraph 38.18 of UL 1008.
  - 2. Units shall be rated based on all classes of loads; i.e., resistive, tungsten, ballast, and inductive loads and all switch sizes shall be suitable for 30% tungsten-filament load. Switches rated at 400 amperes or less shall be UL listed for 100% tungsten lamp loads.
  - 3. Overload and endurance at 480 volts AC per Tables 25.1, 25.2, 27.1 and 27.2 of UL 1008 when enclosed according to Paragraph 1.6
  - 4. Temperature rise tests after the overload and endurance tests to confirm the ability of the transfer switch to carry rated current within the allowable temperature limits
  - 5. No welding of contacts. Transfer switch must be electrically operable to alternate power source after the withstand current tests.
  - 6. Dielectric tests at 1960 volts RMS minimum after the withstand current test
- C. The transfer switches shall be supplied with a microprocessor-based control panel as specified herein.
- D. The closed transition switch shall transfer the load in a parallel mode, thus momentarily connecting both sources of power. A closed transition transfer shall occur only when both sources are available and within specified limits. The maximum interconnect time is 100 milliseconds. The transfer switch shall operate in an "open transition" mode (break-before-make) when the power source serving the load fails.
- E. Each ATS assembly, as well as the means of fastening to the building and/or concrete floor below the concrete equipment pad, shall be capable of withstanding seismic loads. The International Building Code – 2021 Edition and ASCE 7-16 – Minimum Design Loads for Buildings and Other Structures shall be used as the design code with the specific environmental factors as stated below:
  - 1. Earthquake Design Data:

- a. Seismic Importance Factor:  $I = 1.5$
- b. Risk Category: IV
- c. Mapped Spectral Response Accelerations:  $S_s = 0.446$ ,  $S_1 = 0.160$
- d. Site Class: D
- e. Spectral Response Coefficients:  $SDS = 0.429$ ,  $SD1 = 0.243$
- f. Seismic Design Category: D
- g. Component Amplification Factor:  $A_p = 2.5$
- h. Component Response Modification Factor:  $R_p = 2$
- i. Overstrength Factor:  $\Omega_o = 2$
- j. Analysis Procedure: Equivalent Lateral Force ASCE 7-16 Section 13.3

## 2.2 RATINGS

- A. Each ATS shall be rated for 100% continuous duty for all classes of inductive and non-inductive loads. The transfer switches shall be rated for 480 volts, 3-phase, 60 hertz, 3 pole or 4 pole, 4 wire. The ampere rating and number of switched poles for each ATS shall be as indicated on the Drawings.
- B. Each ATS shall be rated for the voltage and ampacity as shown on the Drawings and shall have 600-volt insulation on all parts in accordance with NEMA standards.
- C. The current rating shall be a 24-hour continuous rating when the switch is installed in an unventilated enclosure and shall conform to NEMA temperature rise standards.
- D. The thermal capacity of the main contacts shall not be less than 20 times the continuous duty rating for a minimum of 3 electrical cycles as established by certified test data.
- E. The minimum UL listed Withstand and Closing Ratings shall be 50,000 RMS symmetrical amperes at 480 volts, 60 Hz for 3 cycles with the type of upstream overcurrent protection shown on the Drawings.
- F. All transfer switches shall be "fully rated." A "series rated" switch is not acceptable.
- G. Do not order automatic transfer switches until the required short-circuit current ratings have been determined in accordance with Specification Section 260573 – Protective Device Coordination Study and Arc Flash Risk Assessment.

## 2.3 MICROPROCESSOR BASED CONTROLLER

- A. Each transfer switch shall be equipped with a microprocessor-based control panel. The control panel shall perform the operational and display functions of the transfer switch. The display functions of the control panel shall include ATS position and source availability.
- B. The control panel shall be provided with menu driven display screens for transfer switch monitoring, control and field changeable functions and settings.
- C. The controller shall direct the operation of the transfer switch. The controller's sensing and logic shall be controlled by a built-in microprocessor for maximum reliability,

minimum maintenance, inherent serial communications capability, and the ability to communicate via an Ethernet connection through an internally mounted communications module.

- D. A single controller shall provide single and three phase capability for maximum application flexibility and minimal spare part requirements. Voltage sensing shall be true RMS type and shall be accurate to  $\pm 1\%$  of nominal voltage. Frequency sensing shall be accurate to  $\pm 0.2\%$ . Time delay settings shall be accurate to  $\pm 0.5\%$  of the full-scale value of the time delay. The panel shall be capable of operating over a temperature range of  $-20^{\circ}\text{C}$  to  $60^{\circ}\text{C}$  and a storage temperature from  $-55^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ .
- E. The controller shall be enclosed with a protective cover and be mounted separate from the transfer switch unit for safety and ease of maintenance. The digital display shall be accessible without opening the enclosure door.
- F. Sensing and control logic shall be provided on multi-layer printed circuit boards that are opto-isolated from electrical noise.
- G. Interfacing relays shall be industrial grade plug-in type with dust covers.
- H. A common terminal block shall be provided for all field wiring connections.
- I. The controller shall be connected to the transfer switch by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the controller to be disconnected from the transfer switch for routine maintenance.
- J. The controller shall meet or exceed the requirements for Electromagnetic Compatibility (EMC) as follows:
  - 1. IEC 60947 – 6 – 1 Multiple Function Equipment Transfer Switching Equipment
    - a. IEC 61000-4 Testing and Measurement Techniques – Overview
    - b. IEC 61000-4-2 Electrostatic Discharge Immunity
    - c. IEC 61000-4-3 Radiated RF Field Immunity
    - d. IEC 61000-4-4 Electrical Fast Transient/Burst Immunity
    - e. IEC 61000-4-5 Surge Immunity
    - f. IEC 61000-4-6 Conducted RF Immunity
  - 2. CISPR 11 – Conducted RF Emissions and Radiated RF Emissions
- K. Controller Display and Keypad
  - 1. A backlit four-line, 20-character LCD display and keypad shall be an integral part of the controller for continuous viewing all available data and setting desired operational parameters. Operational parameters shall also be available for viewing and limited control through the serial communications input port. The following parameters shall only be adjustable via DIP switches on the controller.
    - a. Nominal line voltage and frequency
    - b. Single or three phase sensing
    - c. Transfer operating mode configuration, (open transition or delayed transition)

2. All instructions and controller settings shall be easily accessible, readable, and accomplished without the use of codes, calculations, or instruction manuals.
  3. The programming functions shall be pass code protected.
  4. Provide touch pad test switch with Fast Test/Load/No Load positions to simulate a normal source failure.
- L. The following features shall be built-in to the controller, but shall be capable of being activated through keypad programming or the serial communications port when required by the User:
1. Provide the ability to select “commit/no commit to transfer” to determine whether the load should be transferred to the emergency generator if the normal source restores before the generator is ready to accept the load.
  2. In-Phase Monitor: An in-phase monitor shall be provided in the controller to control transfer so that motor load inrush currents do not exceed normal starting currents and shall not require external control of power sources. The in-phase monitor shall be specifically designed for and be the product of the ATS manufacturer.
  3. The controller shall be capable of accepting a normally open contact that will allow the transfer switch to function in a non-automatic mode using an external control device.
  4. Engine Exerciser: The controller shall provide an internal load/no-load engine exerciser. The engine exerciser shall allow the user to program up to seven different exercise routines. For each routine, the user shall be able to:
    - a. Enable or disable the routine
    - b. Enable or disable transfer of the load during routine
    - c. Set the start time; time of day, day of the week, week of the month (1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup>, alternate or every)
    - d. Set the duration of the run

At the end of the specified duration the switch shall transfer the load back to normal and run the generator for the specified cool down period. A 10-year life battery that supplies power to the real time clock in the event of a power loss will maintain all time and date information.
  5. Non-Automatic Mode: Terminals shall be provided for a remote contact which opens to signal the ATS to transfer to emergency and for remote contacts which open to inhibit transfer to emergency and/or retransfer to normal. Both of these inhibit signals can be activated through the keypad or serial communications port.
  6. System Status: The controller LCD display shall include a “System Status” screen which shall be readily accessible from any point in the menu by depressing the “ESC” key a maximum of two times. This screen shall display a clear description of the active operating sequence and switch position. For example:

Normal Failed  
Load on Normal  
TD Normal to Emerg  
2min15s



Controllers that require multiple screens to determine system status or display “coded” system status messages, which must be explained by references in the operator’s manual, are not permissible.

7. Self-Diagnostics: The controller shall contain a diagnostic screen for the purpose of detecting system errors. This screen shall provide information on the status input signals to the controller which may be preventing load transfer commands from being completed.
8. Data Logging: The controller shall have the ability to log data and to maintain the last 99 events, even in the event of total power loss. The following events shall be time and date stamped and maintained in a non-volatile memory:
  - a. Event Logging
    - 1) Date and time and reason for transfer normal to emergency
    - 2) Date and time and reason for transfer emergency to normal
    - 3) Date and time and reason for engine start
    - 4) Date and time engine stopped
    - 5) Date and time emergency source available
    - 6) Date and time emergency source not available
  - b. Statistical Data
    - 1) Total number of transfers
    - 2) Total number of transfers due to source failure
    - 3) Total number of days controller is energized
    - 4) Total number of hours both normal and emergency sources are available
    - 5) Date and time emergency source available

## 2.4 VOLTAGE, FREQUENCY AND PHASE ROTATION SENSING

- A. Voltage and frequency on both the normal and emergency sources (as noted below) shall be continuously monitored, with the following pickup, dropout, and trip settings capabilities (values shown as % of nominal unless otherwise specified).

| <u>Parameter</u>  | <u>Sources</u> | <u>Dropout/Trip</u> | <u>Pickup/Reset</u> |
|-------------------|----------------|---------------------|---------------------|
| Undervoltage      | N & E, 3Φ      | 70 to 98%           | 85 to 100%          |
| Overvoltage       | N & E, 3Φ      | 102 to 115%         | 2% below trip       |
| Underfrequency    | N & E          | 85 to 98%           | 90 to 100%          |
| Overfrequency     | N & E          | 102 to 110%         | 2% below trip       |
| Voltage Unbalance | N&E            | 5 to 20%            | 1% below dropout    |

- B. Repetitive accuracy of all settings shall be within +/-0.5 over an operating temperature of -20°C to 60°C.
- C. Voltage and frequency settings shall be field adjustable in 1% increments either locally with the display and keypad or remotely via serial communications port access.
- D. Source differential sensing shall be provided for the closed transition operating mode. The sensor shall enable transfer/re-transfer between live sources in the closed transition mode

only when the two sources have a maximum voltage differential of 5%, frequency differential of 0.2 Hz and are within 5 electrical degrees. If the normal source becomes unacceptable the controller shall automatically initiate an open transition (break-before-make) load transfer to the emergency source.

- E. Closed transition transfer shall be initiated when operating the transfer test selection switch. Retransfer to the normal source shall operate in closed transition mode at the conclusion of transfer test time delay.
- F. Closed transition transfer shall be accomplished with no power interruption and without altering or actively controlling standby generator set.
- G. The transfer switch controls shall contain the following multiple levels of protection against extended parallel times in excess of 100 ms by taking the following action:
  - 1. If the Normal or Emergency main contacts both remain closed after a preset time delay, the controller shall attempt to return the transfer switch to “safe” state by removing paralleled condition.
    - a. The controller shall open the last set of contacts that closed to remove the overlap condition.
    - b. The controller is locked out from any further automatic operation.
    - c. The “TS Locked Out” indicator (Red LED) shall be illuminated.
    - d. The operation shall remain locked out until the “TS Locked Out” push – button is reset.
  - 2. If the main contacts still remain paralleled after the transfer switch controller action described in paragraph 2.4 G, a second independent extended parallel alarm timer shall then operate an output relay with two (2) Form C contacts to alarm the extended overlap condition and/or shunt trip either the normal or emergency source breaker through a customer connected circuit to the breaker.
- H. The controller shall be capable, via the keypad or through the serial communications port, of sensing the phase rotation of both the normal and emergency sources. The source shall be considered unacceptable if the phase rotation is not the preferred rotation selected (ABC or CBA).
- I. Source status screens shall be provided for both normal and emergency to provide digital readout of voltage on all three phases, frequency and phase rotation. Single-phase sensing on both the normal and the emergency sources shall be provided.
- J. The controller shall include a user selectable algorithm to inhibit retransfer to the normal (utility) source upon detection of a single phasing condition until a dedicated timer expires, the alternate source fails, or the normal source fails completely and is restored during this time delay period. The time delays associated with this feature shall be adjustable by the user through the controller keypad and LCD display.

## **2.5 TIME DELAYS**

- A. A time delay shall be provided to override momentary normal source outages and delay all transfer and engine starting signals, adjustable 0 to 6 seconds. It shall be possible to bypass the time delay from the controller user interface. Initial setting for this time delay shall be

2 seconds. Capability shall be provided to extend the time delay to 60 minutes by means of an external 24 VDC power supply.

- B. A time delay shall be provided on transfer from normal to emergency, adjustable from 0 to 60 minutes, for controlled timing of transfer of loads to emergency. It shall be possible to bypass the time delay from the controller user interface. Initial setting for this time delay shall be 1 seconds.
- C. An adjustable time delay of 0 to 6 seconds to override momentary emergency source outage to delay all retransfer signals during initial loading of engine generator set.
- D. A generator stabilization time delay shall be provided after transfer to emergency adjustable 0 or 4 seconds. Initial setting for this time delay shall be 1 second.
- E. Two (2) time delay modes shall be provided on re-transfer to normal. One time delay shall be for actual normal power failures and the other shall be for the test mode function. The time delays shall be independently adjustable from 0 to 60 minutes. If the emergency source fails during the retransfer time delay, the transfer switch controls shall automatically bypass the time delay and immediately retransfer to the normal position. Initial setting for this time delay shall be 10 minutes.
- F. Time delay on transfer in either direction in the center-off position, programmable 0-2 minutes, factory set at 5 seconds.
- G. A cooldown time delay shall be provided on shutdown of engine generator, Adjustable 0 to 60 minutes. Initial setting for this time delay shall be 0 if engine cooldown timer is included in the generator control panel. Otherwise, the initial setting for this time delay shall be 10 minutes.
- H. A time delay activated output signal shall also be provided to drive an external relay(s) for selective load disconnect control. The controller shall have the ability to activate an adjustable 0 to 5 minutes time delay in any of the following modes:
  - 1. Prior to transfer only
  - 2. Prior to and after transfer
  - 3. Normal to emergency only
  - 4. Emergency to normal only
  - 5. Normal to emergency and emergency to normal
  - 6. All transfer conditions or only when both sources are available
- I. If the alternate source is not accepted within the configured Failure to Accept time delay, the common alert indication shall become active.
- J. The controller shall also include the following built-in time delay for closed transition operation:
  - 1. 1-to-5-minute time delay on failure to synchronize normal and emergency sources prior to closed transition transfer
  - 2. 0.1 to 9.99 second time delay on an extended parallel condition of both power sources during closed transition operation

- K. All adjustable time delays shall be field adjustable in 1 second increments, except the extended parallel time, which shall be adjustable in 0.01 second increments. Timing adjustments shall be executed using the LCD display and keypad or with a remote device connected to the serial communications port. The time delay value displayed on the LCD display or remote device shall be the remaining time until the next event occurs.

## **2.6 CONSTRUCTION AND PERFORMANCE**

- A. Each automatic transfer switch shall be an electrically operated, mechanically held, double-throw switch having a uni-directional drive mechanism. Operating coils shall be momentarily energized from the source to which the load is being transferred. Operating coils shall have coil clearing contacts.
- B. All transfer switch sizes shall use only one type of main operator for ease of maintenance and commonality of parts.
- C. The switch shall be positively locked and unaffected by voltage variations or momentary outages so that contact pressure is maintained at a constant value and temperature rise at the contacts is minimized for maximum reliability and operating life.
- D. The contact structure shall consist of a main current carrying contact which is a silver alloy with a minimum of 50% silver content. Switches rated 800A and above shall have segmented, blow-on construction for high withstand and close-one capability and shall be protected by separate arcing contacts on all sizes.
- E. Inspection of all contacts (movable and stationary) shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors. Switches rated 800A and higher shall have front removable and replaceable contacts. All stationary and moveable contacts shall be replaceable without removing power conductors or bus bars.
- F. Switches composed of molded case breakers, contactors or components thereof will not be acceptable. Main operators which include overcurrent disconnect devices are not acceptable.
- G. The contact transfer time in either direction shall not exceed one-sixth (1/6) of a second.
- H. The transfer switch manufacturer shall submit test data for each size switch, showing it can withstand fault currents of the magnitude and the duration necessary to maintain system integrity. Minimum UL listed withstand and closing ratings shall be 50,000 RMS symmetrical amperes at 480 volts, 60 Hz for 3 cycles with the type of upstream overcurrent protection shown on the Drawings.
- I. A dielectric test at the conclusion of the withstand and closing tests shall be performed.
- J. During open transition operation, the transfer switch manufacturer shall certify arc interrupting capabilities for 50 cycles of operation between a normal and emergency source that are 120 degrees out of phase at 480 volts, 600% of rated current at 0.50 power factor. This certification is to ensure that there will be no current flow between the two isolated sources during switching.

- K. Temperature rise tests in accordance with UL 1008 shall have been conducted after the overload and endurance tests to confirm the ability of the units to carry their rated currents within the allowable temperature limits.
- L. All relays shall be continuous duty industrial type with wiping contacts. Customer interface contacts shall be rated 10 amperes minimum. Coils, relays, timers and accessories shall be front accessible. The control panel and power section shall be interconnected with a harness and keyed disconnect plugs for maintenance.
- M. All coils, relays, timers, and accessories shall be readily front accessible.
- N. Main and arcing contacts shall be visible without major disassembly to facilitate inspection and maintenance.
- O. A manual handle shall be provided for maintenance purposes with the switch de-energized. The handle shall permit the operator to stop the contacts at any point throughout the entire travel to properly inspect and service the contacts when required.
- P. An operator disconnect switch shall be provided to defeat automatic operation during maintenance, inspection or manual operation.
- Q. A means shall be provided to manually operate the transfer switch in the event of switch failure.
- R. Automatic transfer switches must be equipped with a solenoid protection scheme that removes any attempts of operating the solenoids after (3) consecutive trials until manual intervention by an operator.
- S. Each transfer switch shall be mounted in a NEMA 1 enclosure with hinged, lockable front access doors.
  - 1. Due to limited space in the main electrical room, the maximum allowable depth and width of the enclosure for “ATS-2”, “ATS-3” and “ATS-4” shall be:
    - a. ATS-2: 2 feet, 0 inches wide x 1 foot, 6 inches deep
    - b. ATS-3: 2 feet, 0 inches wide x 1 foot, 6 inches deep
    - c. ATS-4: 2 feet, 10 inches wide x 2 feet, 4 inches deep
  - 2. Due to limited space in the main mechanical room, the maximum allowable width and depth of the enclosure for “ATS-6” through “ATS-11” shall be:
    - a. ATS-6: 2 feet, 0 inches wide x 1 foot, 6 inches deep
    - b. ATS-7: 2 feet, 10 inches wide x 1 foot, 8 inches deep
    - c. ATS-8: 2 feet, 0 inches wide x 1 foot, 6 inches deep
    - d. ATS-9: 2 feet, 0 inches wide x 1 foot, 6 inches deep
    - e. ATS-10: 2 feet, 0 inches wide x 1 foot, 6 inches deep
    - f. ATS-11: 2 feet, 0 inches wide x 1 foot, 6 inches deep
- T. Normal, emergency and load terminal arrangement/location within “ATS-2” and “ATS-3” shall match the configuration of the existing ATS that each of these three new ATSs is to replace.

- U. ATS enclosures shall be properly cleaned and prepared for painting and shall have, as a minimum, a baked-on finish consisting of one coat of rust-inhibiting primer and a finish coat, having a minimum dry film thickness of 3 mils of ANSI-61 light gray or ANSI-49 medium gray enamel.

## **2.7 BYPASS-ISOLATION SWITCHES**

- A. A two-way bypass-isolation switch shall provide manual bypass of the load to either source and permit isolation of the automatic transfer switch from all source and load power conductors. All main contacts shall be manually driven.
- B. Power interconnections shall be silver-plated copper bus bar. The only field installed power connections shall be at the service and load terminals of the bypass-isolation switch. All control interwiring shall be provided with disconnect plugs.
- C. Separate bypass and isolation handles shall be utilized to provide clear distinction between the functions. Handles shall be permanently affixed and operable without opening the enclosure door. Designs requiring insertion of loose operating handles or opening of the enclosure door to operate are not acceptable.
- D. Bypass to the load-carrying source shall be accomplished with no interruption of power to the load (make before break contacts). Designs which disconnect the load when bypassing are not acceptable. The bypass handle shall have three operating modes: "Bypass to Normal," "Automatic," and "Bypass to Emergency." The operating speed of the bypass contacts shall be the same as the associated transfer switch and shall be independent of the speed at which the manual handle is operated. In the "Automatic" mode, the bypass contacts shall be out of the power circuit so that they will not be subjected to fault currents to which the system may be subjected.
- E. The isolation handle shall provide three operating modes: "Closed," "Test," and "Open." The "Test" mode shall permit testing of the entire emergency power system, including the automatic transfer switches with no interruption of power to the load. The "Open" mode shall completely isolate the automatic transfer switch from all source and load power conductors. When in the "Open" mode, it shall be possible to completely withdraw the automatic transfer switch for inspection or maintenance to conform to code requirements without removal of power conductors or the use of any tools.
- F. When the isolation switch is in the "Test" or "Open" mode, the bypass switch shall function as a manual transfer switch.
- G. Designs requiring operation of key interlocks for bypass isolation or ATSS which cannot be completely withdrawn when isolated are not acceptable.
- H. Provide auxiliary contacts to indicate all possible switch positions.

## **2.8 SEQUENCE OF OPERATION**

- A. Each ATS shall incorporate adjustable three phase under and over-voltage and three phase under and over-frequency sensing on the normal source.
- B. When the voltage on any phase of the normal source is reduced to 85% of rated voltage for 10 seconds (programmable), a pilot contact shall close to initiate starting of the generator.

- C. Each ATS shall incorporate adjustable three phase under and over-voltage and three phase under and over-frequency sensing on the emergency source.
- D. When the generator is delivering not less than 90% of rated voltage and 95% of rated frequency, the load shall be transferred to the emergency source after an adjustable time delay. During test or other source to source transfer, 95% voltage and frequency, phase rotation and angle shall be verified.
- E. When the normal source has been restored to not less than 95% and not more than 105% of nominal voltage on all phases, proper phase rotation is verified, and after a time delay of 0 to 30 minutes (adjustable), the load shall be transferred to the normal source in a closed transition operation. The generator shall run unloaded for 15 minutes (adjustable) and then shut down. The generator shall be ready for automatic operation upon the next failure of the normal source.
- F. If the engine generator should fail while carrying the load, open transition retransfer to the normal source shall be made instantaneously upon restoration of proper voltage (90%) on the normal source.
- G. A synch check relay shall be provided for closed transition operation. The monitor shall control transfer and retransfer between live sources and operate by sensing the zero-voltage point. It shall be factory set to accomplish transfer within 5 electrical degrees and +/-5% voltage differential. An alarm shall be provided to indicate if closed transition transfer is not accomplished within a preset time period due to a failure to meet operational parameters.
- H. Closed transition transfer in conjunction with over/under-voltage, phase rotation and angle sensing shall be accomplished when both sources are within specified parameters without any power interruption and without altering the speed or actively controlling the generator.
- I. During closed transition operation, the control circuit shall monitor interconnect time. Should connection exceed 100 ms, the set of power contacts just closed shall be reopened and an alarm circuit shall be energized. If the main contacts fail to open, the control system shall energize a 120 VAC shunt trip circuit to the standby feeder breaker serving the transfer switch to disconnect this source and the alarm circuit shall be closed. 120 VAC from an emergency panel shall be supplied for the shunt trips and alarm backup circuits. The anti-parallel fail-safe function shall be controlled by a dedicated auxiliary relay inside the transfer switch enclosure.

## 2.9 ACCESSORIES

- A. Each automatic transfer switch shall include the following items as a minimum.
  - 1. Voltage sensitive relays for full voltage protection
  - 2. A sync check relay shall be provided to ensure the load is transferred between sources (normal to emergency or emergency to normal) only when they are in phase
  - 3. Two (2) auxiliary 120V, 10A, form "C" contacts which change state depending on the voltage source used
  - 4. 2PDT auxiliary 120V, 10A contacts which change state when the emergency source voltage is present at the transfer switch terminals

5. 2PDT auxiliary 120V, 10A contacts which change state when the normal source voltage is present at the transfer switch terminals
6. One (1) auxiliary 120V, 10A form "C" contact which changes state on "normal" line failure
7. A timed auxiliary contact (1 N.C.) adjustable 0-60 seconds shall be provided to allow motor loads to be disconnected prior to transfer in either direction
8. Pilot lights shall be provided on the exterior side of the enclosure door and shall be energized by controller outputs to indicate the following:
  - a. Green to indicate switch is in NORMAL power position
  - b. Red to indicate switch is in the EMERGENCY power position
  - c. White to indicate NORMAL power source is available
  - d. Amber to indicate EMERGENCY power source is available
9. Pilot lights shall be round or square, panel mounted, NEMA Type 12, 16 mm minimum size, 120 volts AC, 60 hertz, using high intensity LED lamps. Lamps shall be replaceable by removal of the color cap. "Neon" type lamps are not acceptable.
10. A lamp test push button shall be provided on the exterior side of the enclosure door, which shall test all pilot lights simultaneously. Push-to-test pilot lights may be provided in lieu of a single lamp test push button.
11. Each pilot light, push button, or selector switch shall be identified with the device manufacturer's engraved collar legend nameplate having the wording as shown on the Drawings or as specified herein.
12. Transfer Switch Test Switch: A two-position key operated selector switch having maintained NORMAL or AUTO position and maintained TEST position, with nameplates indicating TEST and NORMAL or AUTO mounted on the exterior side of the enclosure door.
  - a. The "normal" or "auto" mode shall be for placing the transfer switch control circuitry in normal operation as specified herein.
  - b. The "test" mode shall be for manual simulation of "normal" power source failure or outage (as herein specified in Article 2.8 of this Section).
  - c. Switching the selector switch back to the "normal" or "auto" mode position from the "test" mode position shall manually simulate the return of the "normal" power source and shall activate all phases of operation associated therewith.
13. Engine-Generator Set Starting Contact: A SPDT contact, rated 5 amps at 30 VDC, shall be provided for a low-voltage engine start signal. The start signal shall prevent dry cranking of the engine by requiring the generator set to reach proper output and run for the duration of the cool down setting, regardless of whether the normal source restores before the load is transferred.
14. Provide a momentary pushbutton to bypass the time delays on transfer and retransfer and programmable commit/no commit control logic.
15. Provide terminals for remote test/peak shave operation and transfer inhibit to the emergency source.



16. External DC Power Supply Provisions: Provide provisions for connection of an external 24 VDC power supply to allow the LCD and the door mounted control indicators to remain functional when both power sources are dead.

## **2.10 COMMUNICATIONS**

- A. Provide all hardware and software required for Modbus TCP/IP or Modbus RTU (to be determined at time of shop drawing submittal review) communications between all nine (9) new ATSs and the Owner's existing Niagara building automation system (BAS). Coordinate with Specification Section 260900 – Instrumentation and Control for Electrical Systems requirements.
- B. All communications hardware shall be UL 1008 listed and labeled.
- C. Include control power transformer or power supply as required to power the communications hardware.
- D. Hardware shall be capable of operating in ambient temperatures from -4°F to 140°F.
- E. Provide real-time monitoring and data logging of the power source status and the switch position of each ATS, including the maintenance bypass switch position if applicable.
- F. Provide pick-ups, drop-outs, time delays, engine exerciser schedule and feature settings for each ATS.
- G. Provide NFPA test and utility outage information to meet NFPA and Joint Commission compliance requirements.
- H. The communications module shall include the following features:
  - 1. Email notifications and SNMP traps of selectable events and alarms may be sent to a mobile device or PC.
  - 2. Modbus TCP/IP, SNMP, HTTP, SMTP open protocols shall be simultaneously supported.
  - 3. Web app interface requiring user credentials to monitor and control the transfer switch supporting modern smart phones, tablets and PC browsers. User shall be able to view the dynamic on-line, ATS controls status, alarms, metering, event logging as well as settings.
  - 4. Secure access shall be provided by requiring credentials for a minimum of 3 user privilege levels to the web app.
    - a. Monitor (view only)
    - b. Control (view and control)
    - c. Administrator (view, control and change settings)
  - 5. 128-bit AES encryption standard shall be supported for all means of connectivity.
  - 6. Allow for the initiating of transfers, retransfers, bypassing of active timers and activating/deactivating of engine start signal shall be available over the embedded webpage and to the transfer switch vendor's monitoring equipment.

7. An event log displaying a minimum of three hundred (300) events shall be viewable and printable from the embedded webpages and accessible from supported open protocols.
8. Four (4) 100Mbps Ethernet copper RJ-45 ports, two (2) serial ports, termination dipswitches and LEDs for diagnostics.
9. DIN rail mountable.

## **2.11 NAMEPLATES**

- A. All devices mounted on the transfer switch enclosure door, as well as individual items mounted inside the enclosure, shall be provided with a nameplate to show the identification and/or function of the device or item.
- B. All nameplates shall be engraved laminated plastic in accordance with Section 260553 – Identification for Electrical Systems. Unless otherwise indicated, all nameplates shall have 1/4-inch high characters.

## **2.12 APPROVED MANUFACTURERS**

- A. Closed-transition automatic transfer and closed-transition automatic transfer with bypass-isolation switches shall be as manufactured by:
  1. Automatic Switch Co., 7000 Series
  2. Russelectric Inc., RTS-03 Series
  3. ABB-GE Zenith Controls, Inc., ZTS Series
- B. The basis of design for the closed-transition automatic transfer and closed-transition automatic transfer with bypass-isolation switches is the ASCO 7000 Series. Should the Contractor choose to include one of the approved equal manufacturers, he will be responsible for any additional costs resulting from physical changes and/or required accessories to make the equipment work with the existing conditions at the Facility.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. The Contractor shall verify NEC clearances as indicated on the Drawings prior to installation. Working space and clearances shall be in accordance with NEC Article 110. Verify UL labeling of the assembly prior to installation.
- B. The Contractor shall follow the installation instructions supplied by the manufacturer.
- C. Rig each ATS assembly into final location and install on level, 3-1/2" high concrete housekeeping pad, with 1" chamfered top edge, per Section 260500 – Common Work Results for Electrical. The pad shall be 2" larger than the ATS enclosure in the front and on both sides as shown on the Drawings and in accordance with Section 260500 – 2.3 – Equipment Pads and Anchor Bolts.
- D. Each ATS shall be bolted to the concrete floor using expansion anchor bolts meeting the requirements of Section 260529 – Hangers and Supports for Electrical Equipment. Anchor bolt size, quantity and placement shall be as indicated in the ATS manufacturer's installation instructions for seismic freestanding certification. Anchor bolts shall extend

through the concrete housekeeping pad to provide the required embedment in the concrete floor below the housekeeping pad. As a minimum, provide one anchor bolt at each corner with 6" minimum embedment into the concrete floor below the housekeeping pad.

- E. All conduits which terminate at the top of an ATS shall be terminated in insulated throat, grounding type, liquid tight rigid conduit hubs in accordance with Section 260533.13 – Conduit for Electrical Systems. Grounding lug on the lock nut of each conduit hub shall be connected to the ATS interior ground bus bar in accordance with Section 260526 – Grounding and Bonding for Electrical Systems.
- F. Where a new ATS is to be installed in the same location as an existing ATS, and the existing conductors are indicated to remain in place, extend existing conductors to the appropriate terminals on the new switch if/as required utilizing in-line, long-barrel compression connectors with cold shrink insulating tubes in accordance with Section 260583 – Wiring Connections.
- G. Torque all bolted connections made in the field in accordance with manufacturer's published values using calibrated torque wrench.

### **3.2 ARC FLASH HAZARD WARNING LABEL**

- A. Provide arc flash hazard warning label on exterior door of all automatic transfer switches in accordance with Sections 260553 - Identification for Electrical Systems and 260573 – Protective Device Coordination Study and Arc Flash Risk Assessment.

### **3.3 TESTS**

- A. Each transfer switch, complete with all timers, relays, and accessories shall be listed by Underwriters' Laboratories, Inc. (UL), and shall have been tested, approved, and rated for total system load according to UL Standard 1008, including short circuit test.
- B. The transfer switch manufacturer shall submit test data for each switch, verifying that the switch can withstand, without damage, fault currents of the magnitude and the duration necessary to maintain the system integrity.
- C. All production units shall be subjected to the following factory tests:
  - 1. The complete transfer switch shall be tested to ensure proper operation.
  - 2. The transfer switch shall be subjected to a dielectric strength test per NEMA Standard ICS1-109.21.
- D. The normal and emergency power supplying each automatic transfer switch shall be tested for comparable phase relationships.
- E. Each automatic transfer switch shall have its normal power interrupted in order to ensure fully automatic shifting of power from its normal source to emergency power.
- F. Each transfer switch shall be tested for operation below 85% rated voltage. Also test the contacts and signal that activates the diesel-electric generator set and confirm the closing of the emergency contacts when the generator is up to 90% rated voltage.
- G. All test switches and pilot lights shall be tested for correct operation and sequence.

- H. Verify proper operation of the TCP/IP or BACnet IP communications interface with the Owner's existing Niagara BAS. Coordinate with the BAS Contractor.
- I. All emergency power system tests shall be tested in the presence of and approved by the Construction Representative.

### **3.4 TRAINING**

- A. Provide two (2) hours of on-site training by factory trained field service technician to instruct the Owner's personnel in the proper operation and routine maintenance of the equipment. Review operation and maintenance manuals, parts manuals and emergency service procedures. This shall be done after completion of the acceptance testing. Training session shall be video recorded, and two (2) copies of the video shall be provided to the Owner on DVD disc or USB thumb drive.

**END OF SECTION 263623.13**

## SECTION 263623.16 – AUTOMATIC TRANSFER SWITCH FOR FIRE PUMP

### 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 SCOPE

- A. The Contractor shall furnish and install an automatic transfer switch for the existing fire pump (FPATS) as specified herein and as shown on the Drawings.
- B. The FPATS shall automatically transfer the fire pump and jockey pump motor loads from the normal power source to the new emergency generator specified in Section 263213.13 – Diesel-Engine-Driven Generator Set upon a failure of the normal power source.
- C. The FPATS shall transfer its connected load by means of a break-before-make (open transition) transfer.

#### 1.3 RELATED SECTIONS

- A. Section 260500 – Common Work Results for Electrical
- B. Section 260526 – Grounding and Bonding for Electrical Systems
- C. Section 260529 – Hangers and Supports for Electrical Equipment
- D. Section 260533.13 – Conduit for Electrical Systems
- E. Section 260553 – Identification for Electrical Systems
- F. Section 260573 – Protective Device Coordination Study and Arc Flash Risk Analysis
- G. Section 260583 – Wiring Connections
- H. Section 260900 – Instrumentation and Control for Electrical Systems
- I. Section 263213.13 – Diesel-Engine-Driven Generator Set

#### 1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's product data for fire pump automatic transfer switch including, but not limited to, service voltages, number of phases, frequency, continuous current ratings, interrupting current ratings and enclosure type. Product data sheets shall indicate all standard features, special features and optional features that are to be provided. Provide data on microprocessor based ATS controller including programming options.
- B. Shop Drawings: Submit dimensioned plan view and elevation view outline drawings and internal physical diagrams for FPATS.
- C. Wiring Diagrams: Submit wiring diagrams for FPATS showing internal and external connections for power, control and communications wiring.

Change in Scope, Re-Bid: Replace Emergency Generator, Infrastructure  
St. Louis Forensic Treatment Center - South, St. Louis, Missouri

M1908-01

- D. Seismic Certification: Provide seismic free-standing qualification certificate for FPATS assembly.
- E. The FPATS submittals will not be approved until the required short-circuit current ratings have been determined in accordance with Specification Section 260573 – Protective Device Coordination Study and Arc Flash Risk Assessment.
- F. Submit Operation and Maintenance (O&M) Manuals in accordance with the General Conditions Section of these Specifications no later than ten (10) working days prior to the substantial completion inspection. The O&M Manuals must include the entire FPATS assembly, including the enclosure, all internal components, a bill of materials and a recommended spare parts list. Manuals that only include the controller will not be acceptable.
- G. O&M Manuals shall be conformed to “as-built” status by incorporating any and all changes made during the startup period.

## 1.5 REFERENCES

- A. The FPATS shall be designed and manufactured according to the applicable provisions of the latest revision of the following codes and standards:
  - 1. ANSI/IEEE C62.1 – IEEE Standard for Gapped Silicon-Carbide Surge Arresters for AC Power Circuits
  - 2. ANSI/IEEE C62.11 – IEEE Standard for Metal-Oxide Surge Arresters for Alternating Current Power Circuits (> 1kV)
  - 3. NFPA 20 – Standard for the Installation of Stationary Pumps for Fire Protection
  - 4. NFPA 70 – National Electrical Code, including use in emergency and standby systems in accordance with Articles 700, 701, 702 and 708
  - 5. NFPA 101 – Life Safety Code
  - 6. NFPA 110 – Standard for Emergency and Standby Power Systems
  - 7. IEEE Standard 446 – IEEE Recommended Practice for Emergency and Standby Power Systems (Orange Book)
  - 8. IEEE Standard 241 – IEEE Recommended Practice for Electric Power Systems in Commercial Buildings (Gray Book)
  - 9. IEEE Standard 472 (ANSI C37.90A) – Ringing Wave Immunity
  - 10. NEMA Standard ICS10 – AC Automatic Transfer Switches
  - 11. UL 50 – Enclosures for Electrical Equipment
  - 12. UL 508 – Industrial Control Equipment
  - 13. UL 1008 – Standard for Transfer Switch Equipment
  - 14. EN55022 Class B – (CISPR11): Conducted and Radiated Emissions
  - 15. EN61000-4-2 (Level 4) – Electrostatic Discharge (ESD) Immunity Test
  - 16. EN61000-4-3 (ENV50140) – Radiated Electromagnetic Field Immunity Test
  - 17. EN61000-4-4 – Electrical Fast Transient (EFT)/Burst Immunity Test
  - 18. EN61000-4-5 (IEEE C62.41) – Surge Transient Immunity Test

19. EN61000-4-6 (ENV50141) – Conducted Radio-Frequency (RF) Field Immunity Test
20. EN61000-4-11 – Voltage Dips and Interruption Immunity

## **1.6 QUALIFICATIONS**

- A. The manufacturer of the FPATS assembly shall have produced similar electrical equipment for a minimum of fifteen (15) years. When requested by the Designer, an acceptable list of a minimum of ten (10) installations with similar equipment shall be provided to demonstrate compliance with this requirement.
- B. The FPATS and control modules shall be the product of the same manufacturer.
- C. As a precondition for approval, the FPATS, complete with accessories, shall be listed by Underwriters Laboratories, under Standard UL 1008 (automatic transfer switches) and approved for use on emergency systems for fire pump service meeting the requirements of the latest edition of NFPA 20 (fire pumps).
- D. Provide equipment that is IBC/CBC seismically qualified with seismic freestanding label.

## **1.7 DELIVERY, STORAGE AND HANDLING**

- A. Inspect equipment and report concealed damage to carrier within their required time period.
- B. Handle equipment carefully and in accordance with manufacturer's recommendations to avoid damage to internal components, enclosure, and finish.
- C. Store equipment in a clean, dry indoor environment. Maintain factory packaging until time of installation. Cover with heavy canvas or plastic to keep out dirt, water and construction debris. Heat enclosures to prevent condensation.

## **1.8 WARRANTY**

- A. Manufacturer shall warrant equipment to be free from defects in materials and workmanship for a minimum period of one (1) year from date of substantial completion of the project.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- A. The FPATS shall automatically transfer the assigned load (L) from the "Normal" (N) source to the "Emergency" (E) source upon a loss of normal source power and automatically retransfer back again upon restoration of normal source power.
- B. Switching operation shall be break-before-make (open transition).
- C. The FPATS shall be UL Listed in accordance with UL 1008 as follows:
  1. Rated based on the fire pump motor horsepower
  2. Overload and endurance at 480 volts AC per Tables 25.1, 25.2, 27.1 and 27.2 of UL 1008 when enclosed according to Paragraph 1.6

3. Temperature rise tests after the overload and endurance tests to confirm the ability of the transfer switch to carry rated current within the allowable temperature limits
  4. No welding of contacts. Transfer switch must be electrically operable to alternate power source after the withstand current tests.
  5. Dielectric tests at 1960 volts RMS minimum after the withstand current test
- D. The FPATS shall be supplied with a microprocessor-based control panel as specified herein.
- E. The FPATS assembly, as well as the means of fastening to the building and/or concrete floor below the concrete equipment pad, shall be capable of withstanding seismic loads. The International Building Code – 2021 Edition and ASCE 7-16 – Minimum Design Loads for Buildings and Other Structures shall be used as the design code with the specific environmental factors as stated below:
1. Earthquake Design Data:
    - a. Seismic Importance Factor:  $I = 1.5$
    - b. Risk Category: IV
    - c. Mapped Spectral Response Accelerations:  $S_s = 0.446$ ,  $S_1 = 0.160$
    - d. Site Class: D
    - e. Spectral Response Coefficients:  $SDS = 0.429$ ,  $SD1 = 0.243$
    - f. Seismic Design Category: D
    - g. Component Amplification Factor:  $A_p = 2.5$
    - h. Component Response Modification Factor:  $R_p = 2$
    - i. Overstrength Factor:  $\Omega_o = 2$
    - j. Analysis Procedure: Equivalent Lateral Force ASCE 7-16 Section 13.3

## 2.2 RATINGS

- A. The FPATS shall have an ampere rating not less than 115% of the fire pump motor full-load current. The transfer switch shall be rated for 480 volts, 3-phase, 60 hertz, 3 pole, 3 wire. The horsepower rating of the switch shall be as indicated on the Drawings.
- B. The FPATS shall have 600-volt insulation on all parts in accordance with NEMA standards.
- C. The minimum UL listed Withstand and Closing Ratings shall be 65,000 RMS symmetrical amperes at 480 volts, 60 Hz for 3 cycles.
- D. The FPATS shall be "fully rated." A "series rated" switch is not acceptable.
- E. Do not order the FPATS until the required short-circuit current rating has been determined in accordance with Specification Section 260573 – Protective Device Coordination Study and Arc Flash Risk Assessment.



## 2.3 CONSTRUCTION AND PERFORMANCE

- A. The FPATS shall be an electrically operated, mechanically held, double-throw switch having a uni-directional drive mechanism. Operating coils shall be momentarily energized from the source to which the load is being transferred. Operating coils shall have coil clearing contacts.
- B. The FPATS shall be delayed transition type with a maximum delay of 3 seconds in accordance with NFPA 20-10.8.2.2(6).
- C. The switch shall be positively locked and unaffected by voltage variations or momentary outages so that contact pressure is maintained at a constant value and temperature rise at the contacts is minimized for maximum reliability and operating life.
- D. The contact transfer time in either direction shall not exceed one-sixth (1/6) of a second.
- E. The contact structure shall consist of a main current carrying contact which is a silver alloy with a minimum of 50% silver content. The current carrying contacts shall be protected by silver tungsten arcing contacts on all sizes.
- F. Means shall be provided to prevent higher than normal in-rush currents when transferring the fire pump motor from one source to the other per NFPA 20-10.8.3.10. The use of an "in-phase monitor" to meet this requirement is prohibited. The use of an intentional delay via an open neutral position of the transfer switch to comply with this requirement shall be permitted.
- G. The transfer switch manufacturer shall submit test data for each size switch, showing it can withstand fault currents of the magnitude and the duration necessary to maintain system integrity. Minimum UL listed withstand and closing ratings shall be 65,000 RMS symmetrical amperes at 480 volts, 60 Hz for 3 cycles.
- H. A dielectric test at the conclusion of the withstand and closing tests shall be performed.
- I. The transfer switch manufacturer shall certify arc interrupting capabilities for 50 cycles of operation between a normal and emergency source that are 120 degrees out of phase at 480 volts, 600% of rated current at 0.50 power factor. This certification is to ensure that there will be no current flow between the two isolated sources during switching.
- J. Temperature rise tests in accordance with UL 1008 shall have been conducted after the overload and endurance tests to confirm the ability of the units to carry their rated currents within the allowable temperature limits.
- K. All relays shall be continuous duty industrial type with wiping contacts. Customer interface contacts shall be rated 10 amperes minimum. Coils, relays, timers and accessories shall be front accessible. The control panel and power section shall be interconnected with a harness and keyed disconnect plugs for maintenance.
- L. All coils, relays, timers, and accessories shall be readily front accessible.
- M. Main and arcing contacts shall be visible without major disassembly to facilitate inspection and maintenance.

- N. A single uni-gear motor shall electrically operate the transfer mechanism. It shall also be capable of being operated manually and shall have suitable provisions for readily disengaging the gear motor when necessary.
- O. Inspection of all contacts (movable and stationary) shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors, to facilitate inspection and maintenance.
- P. A manual handle shall be provided for maintenance purposes with the switch de-energized. The handle shall permit the operator to stop the contacts at any point throughout the entire travel to properly inspect and service the contacts when required.
- Q. The transfer switch shall be mechanically and electrically interlocked so that it shall not be possible for the load circuits to be connected to the normal and emergency sources simultaneously, regardless of whether the switch is electrically or mechanically operated. The switch shall have a manual neutral.
- R. Switches composed of molded case breakers, contactors or components thereof will not be acceptable.
- S. An auxiliary contact shall be provided to prevent sending of the signal for starting of the alternate source generator when the transfer switch commands it if the isolation switch on the alternate side of the transfer switch is open. This "isolation switch" is the fire pump emergency feeder circuit breaker located in the "Main Emergency Switchboard No. 1" (MESB1) located in the main electrical room (Room C122).
- T. Provide means to monitor the integrity of the generator remote start circuit for broken, disconnected or shorted wires and start the generator upon loss of integrity of the start circuit wiring in accordance with NEC 695.14 (F).
- U. The transfer switch shall be provided with locked rotor overcurrent protection. The locked rotor protector shall be calibrated and set to a minimum of 300% of the fire pump motor full-load current and have a tripping time between 8 and 20 seconds.
- V. The transfer switch shall be mounted in a NEMA 12, dust-proof and drip-proof, free-standing enclosure with hinged, lockable front access door.
- W. Enclosure shall be properly cleaned and prepared for painting and shall have, as a minimum, a powder baked finish consisting of one coat of rust-inhibiting primer and a finish coat, having a minimum dry film thickness of 3 mils of "fire engine" red enamel.

## **2.4 MICROPROCESSOR CONTROLLER**

- A. A solid-state sensing and control logic panel shall be separately mounted from the power-switching portion of the transfer switch. The two sections shall be connected together by control cables and plug-in connectors. The control section shall be capable of being isolated from the power section for maintenance.
- B. The normal power source shall be set to pickup at 95% and drop out at 85% of nominal supply voltage. The voltage sensing of the alternate supply shall be set to pickup at 95% of nominal supply voltage.
- C. All voltage sensing, frequency sensing and timer set points shall be field adjustable.

- D. The transfer switch shall automatically transfer its load circuit to an emergency or alternate power supply upon failure of the normal or original supply. In order to override momentary fluctuations in the system, a time delay transfer from normal to alternate power supply shall be adjustable up to 1800 seconds. Upon restoration of the normal supply, the transfer switch shall automatically retransfer its load circuits to the normal supply. Mechanically held transfer mechanisms shall be energized only momentarily during transfer or retransfer.
- E. If the emergency/standby power should fail while carrying the load, transfer to the normal supply shall be made instantaneously upon restoration of the normal source to satisfactory conditions.
- F. The transfer switch shall come complete with five (5) LEDs to provide visual indication of the unit status, source 1 available, source 1 connected, source 2 available, and source 2 connected.
- G. An engine test button shall be provided that will initiate a test of the generator.
- H. Include provisions to supervise the isolating switch ahead of the alternate source input terminals of the FPATS; fire pump emergency feeder circuit breaker in the “Main Emergency Switchboard No. 1” (MESB1) with an audible and visible signal on the FPATS to indicate when the “isolating switch” (circuit breaker) is not closed.
- I. An alarm silence button shall be provided that will silence the alarm buzzer on the FPATS.

## **2.5 COMMUNICATIONS**

- A. Provide all hardware and software required for Modbus TCP/IP or BACnet IP (to be determined at time of shop drawing submittal review) communications between the FPATS and the Owner’s existing Niagara building automation system (BAS). Coordinate with Specification Section 260900 – Instrumentation and Control for Electrical Systems requirements.
- B. All communications hardware shall be UL 1008 listed and labeled.
- C. Include control power transformer or power supply as required to power the communications hardware.
- D. Hardware shall be capable of operating in ambient temperatures from -4°F to 140°F.
- E. Provide real-time monitoring and data logging of the power source status and the switch position of the FPATS.
- F. Provide pick-ups, drop-outs, time delays, engine exerciser schedule and feature settings for the FPATS.
- G. Provide NFPA test and utility outage information to meet NFPA and Joint Commission compliance requirements.

## **2.6 ACCESSORIES**

- A. Alarm relays
  - 1. One (1) Form C contact shall be provided for remote indication for source 1 connected or source 2 connected.

2. Two (2) Form C contacts shall be provided for remote indication for the alternate source-isolating switch open.
- B. Voltage surge arrester
1. Provide a voltage surge arrester complying with ANSI/IEEE C62.1 or C62.11 connected from each phase to ground in accordance with NFPA 20-10.4.1 requirements.
  2. The surge arrester shall be rated to suppress voltage surges above line voltage.
  3. Ship loose for field installation at the fire pump controller junction box.

## **2.7 NAMEPLATES**

- A. All devices mounted on the transfer switch enclosure door, as well as individual items mounted inside the enclosure, shall be provided with a nameplate to show the identification and/or function of the device or item.
- B. All nameplates shall be engraved laminated plastic in accordance with Section 260553 – Identification for Electrical Systems. Unless otherwise indicated, all nameplates shall have 1/4-inch high characters.

## **2.8 APPROVED MANUFACTURERS**

- A. Automatic transfer switch for fire pump shall be Eaton Model FPATS or approved equal by ASCO or Firetrol.
- B. The basis of design for the automatic transfer switch for fire pump is the Eaton Model FPATS stand-alone transfer switch. Should the Contractor choose to include one of the approved equal manufacturers, he will be responsible for any additional costs resulting from physical changes and/or required accessories to make the equipment work with the existing conditions at the Facility.

# **PART 3 - EXECUTION**

## **3.1 INSTALLATION**

- A. The Contractor shall verify NEC clearances as indicated on the Drawings prior to installation. Working space and clearances shall be in accordance with NEC Article 110. Verify UL labeling of the assembly prior to installation.
- B. The Contractor shall follow the installation instructions supplied by the manufacturer.
- C. Install the FPATS on the concrete floor of the fire pump room (Room C123A) where indicated on the Drawings.
- D. Enclosure shall be bolted to the concrete floor using expansion anchor bolts meeting the requirements of Section 260529 – Hangers and Supports for Electrical Equipment. Anchor bolt size, quantity and placement shall be as indicated in the ATS manufacturer's installation instructions for seismic freestanding certification. As a minimum, provide one anchor bolt at each corner with 6" minimum embedment.

- E. Provide U-channel supports, in accordance with Section 260529 – Hangers and Supports for Electrical Equipment, if the manufacturer requires support of the equipment in addition to anchor bolting the enclosure to the concrete floor.
- F. All conduits, power, control and communications, shall terminate in insulated throat, grounding type, liquid tight conduit hubs, in accordance with Section 260533.13 – Conduit for Electrical Systems, in the bottom of the enclosure in the location designated on the equipment shop drawing submittals. Grounding lug on the lock nut of each conduit hub shall be connected to the ATS interior ground bus bar in accordance with Section 260526 – Grounding and Bonding for Electrical Systems.
- G. Terminate all conductors using calibrated torque wrench per manufacturer's torque specifications.
- H. Install the SPD shipped loose with the FPATS in an insulated throat, grounding type, liquid tight conduit hub, in accordance with Section 260533.13 – Conduit for Electrical Systems, in a 1/2" or 3/4" hole, as required, punched in the side or bottom of the fire pump controller junction box and splice to the fire pump controller supply conductors and jockey pump supply conductors using multi-tap mechanical or compression type connectors in accordance with Section 260583 – Wiring Connections.

### **3.2 ARC FLASH HAZARD WARNING LABEL**

- A. Provide arc flash hazard warning label on exterior door of all automatic transfer switches in accordance with Sections 260553 - Identification for Electrical Systems and 260573 – Protective Device Coordination Study and Arc Flash Risk Assessment.

### **3.3 TESTS**

- A. The transfer switch, complete with all timers, relays, and accessories shall be listed by Underwriters' Laboratories, Inc. (UL), and shall have been tested, approved, and rated for total system load according to UL Standard 1008, including short circuit test.
- B. The transfer switch manufacturer shall submit test data for the switch, verifying that the switch can withstand, without damage, fault currents of the magnitude and the duration necessary to maintain the system integrity.
- C. All production units shall be subjected to the following factory tests:
  - 1. The complete transfer switch shall be tested to ensure proper operation.
  - 2. The transfer switch shall be subjected to a dielectric strength test per NEMA Standard ICS1-109.21.
- D. The normal and emergency power supplying the automatic transfer switch shall be tested for comparable phase relationships.
- E. The automatic transfer switch shall have its normal power interrupted in order to insure fully automatic shifting of power from its normal source to emergency power.
- F. The transfer switch shall be tested for operation below 85% rated voltage. Also test the contacts and signal that activates the diesel-electric generator set and confirm the closing of the emergency contacts when the generator is up to 90% rated voltage.

- G. All test switches and pilot lights shall be tested for correct operation and sequence.
- H. All emergency power system tests shall be completed by a factory authorized field service technician in the presence of and approved by the Construction Representative.

### **3.4 TRAINING**

- A. Provide two (2) hours of on-site training by factory trained field service technician to instruct the Owner's personnel in the proper operation and routine maintenance of the equipment. Review operation and maintenance manuals, parts manuals and emergency service procedures. This shall be done after completion of the acceptance testing. Training session shall be video recorded and two (2) copies of the video shall be provided to the Owner on DVD disc or USB thumb drive.

**END OF SECTION 263623.16**

## **SECTION 311000 - SITE CLEARING**

### **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. Temporary erosion- and sedimentation-control measures.
- B. Related Sections:
  - 1. Division 01 Section "Temporary Facilities and Controls" for temporary utility services, construction and support facilities, security and protection facilities, and temporary erosion- and sedimentation-control measures.

#### **1.3 DEFINITIONS**

- A. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- B. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.
- C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow.
- D. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

#### **1.4 MATERIAL OWNERSHIP**

- A. Except for stripped topsoil and other materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

#### **1.5 SUBMITTALS**

- A. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

#### **1.6 PROJECT CONDITIONS**

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
  - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.

2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
- B. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises.
- C. Utility Locator Service: Notify utility locator service "Missouri One Call System" (<https://www.mocall.com/>; phone 811) for area where Project is located before site clearing.
- D. Do not commence site clearing operations until temporary erosion- and sedimentation-control, specified in Division 01 Section "Temporary Facilities and Controls," measures are in place.
- E. The following practices are prohibited within protection zones:
  1. Storage of construction materials, debris, or excavated material.
  2. Parking vehicles or equipment.
  3. Erection of sheds or structures.
  4. Impoundment of water.
  5. Excavation or other digging unless otherwise indicated.
  6. Attachment of signs to or wrapping materials around trees or plants.
- F. Do not direct vehicle or equipment exhaust towards project area or fresh air intakes in surrounding buildings.
- G. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Division 31 Section "Earth Moving."
  1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Protect existing site improvements to remain from damage during construction.
  1. Restore damaged improvements to their original condition, as acceptable to Owner.



### **3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL**

- A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control requirements of authorities having jurisdiction.
- B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
- C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
- D. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- E. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

### **3.3 EXISTING UTILITIES**

- A. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

### **3.4 SITE IMPROVEMENTS**

- A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate Scope of Work shown on drawings.

### **3.5 DISPOSAL OF SURPLUS AND WASTE MATERIALS**

- A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.
- B. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities. Do not interfere with other Project work.

**END OF SECTION 311000**

## **SECTION 312000 - EARTH MOVING**

### **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. Excavating and backfilling for buildings and structures.
  - 2. Drainage course for concrete slabs-on-grade.
  - 3. Subbase course for concrete walks.
  - 4. Retain subparagraph below if elevator work includes in-ground cylinder but cylinder excavation (normally part of elevator work) is not part of elevator work.
- B. Related Sections:
  - 1. Division 01 Section "Temporary Facilities and Controls" for temporary controls, utilities, and support facilities; also for temporary site fencing if not in another Section.

#### **1.3 DEFINITIONS**

- A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
  - 1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
  - 2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.
- C. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- D. Excavation: Removal of material encountered above existing structure footing elevations and to lines and dimensions indicated.
  - 1. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be without additional compensation and shall be corrected at contractor's cost.
- E. Fill: Soil materials used on top of and/or along-side existing foundation walls.
- F. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- G. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

Change in Scope, Re-Bid: Replace Emergency Generator, Infrastructure  
St. Louis Forensic Treatment Center - South, St. Louis, Missouri

M1908-01

- H. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

#### **1.4 SUBMITTALS**

- A. Product Data: For each type of the following manufactured products required:
  - 1. Warning tapes.
- B. Qualification Data: For qualified testing agency.
- C. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:
  - 1. Classification according to ASTM D 2487.
  - 2. Laboratory compaction curve according to ASTM D 698 or ASTM D 1557 as noted herein.

#### **1.5 QUALITY ASSURANCE**

- A. Blasting: Blasting is prohibited.
- B. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.
- C. Preexcavation Conference: Conduct conference at Project site.

#### **1.6 PROJECT CONDITIONS**

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations.
  - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
  - 2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
- B. Utility Locator Service: Notify utility locator service "Missouri One Call System" (<https://www.molcall.com/>; phone 811) for area where Project is located before beginning earth moving operations.
- C. Do not commence earth moving operations until temporary erosion- and sedimentation-control measures, specified in Division 01 Section "Temporary Facilities and Controls," are in place.
- D. The following practices are prohibited within protection zones:
  - 1. Storage of construction materials, debris, or excavated material.
  - 2. Parking vehicles or equipment.
  - 3. Erection of sheds or structures.
  - 4. Impoundment of water.
  - 5. Excavation or other digging unless otherwise indicated.

6. Attachment of signs to or wrapping materials around trees or plants.
- E. Do not direct vehicle or equipment exhaust towards protection zones.
- F. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

## **PART 2 - PRODUCTS**

### **2.1 SOIL MATERIALS**

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, SM, GC, SC, CL, ML according to ASTM D 2487 or a combination of these groups; free of rock or gravel larger than 3/4 inches (16 mm) in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
  1. Liquid Limit: < 50.
  2. Plasticity Index: plots above the A-line.
- C. Unsatisfactory Soils: Soil Classification Groups OL, CH, MH, OH, and PT according to ASTM D 2487 or a combination of these groups.
  1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
- D. Drainage Layer and Filter Gravel: Narrowly graded mixture of crushed stone, or crushed or uncrushed gravel;, conforming to MoDOT Section 1007.2 Type 2 Aggregate Gradation A.
- E. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch (25-mm) sieve and 0 to 5 percent passing a No. 4 (4.75-mm) sieve.
- F. Sand: ASTM C 33; fine aggregate.
- G. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

### **2.2 ACCESSORIES**

- A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility; colored as follows:
  1. Red: Electric.
  2. Yellow: Gas, oil, steam, and dangerous materials.
  3. Orange: Telephone and other communications.
  4. Blue: Water systems.
  5. Green: Sewer systems.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.
- B. Protect and maintain erosion and sedimentation controls during earth moving operations.
- C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

### **3.2 DEWATERING**

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
  - 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

### **3.3 EXPLOSIVES**

- A. Explosives: Explosives are prohibited. Do not use explosives.

### **3.4 EXCAVATION, GENERAL**

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
  - 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

### **3.5 EXCAVATION FROM OVER, AND AROUND, BURIED STRUCTURES**

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch (25 mm). If applicable, extend excavations a sufficient distance from structures for installing services and other construction, and for inspections.

### **3.6 EXCAVATION FOR WALKS**

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

### **3.7 EXCAVATION FOR UTILITY TRENCHES**

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.
- B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches (300 mm) higher than top of pipe or conduit unless otherwise indicated.
  1. Clearance: 4 inches (100 mm) each side of drain pipe.
- C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
  1. For pipes and conduit less than 6 inches (150 mm) in nominal diameter, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
  2. For pipes and conduit 6 inches (150 mm) or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe or conduit circumference. Fill depressions with tamped sand backfill.
  3. For flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support conduit on an undisturbed subgrade.
  4. Excavate trenches 6 inches (150 mm) deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.
- D. Trench Bottoms: Excavate trenches 4 inches (100 mm) deeper than bottom of pipe and conduit elevations to allow for bedding course.
  1. Excavate trenches 6 inches (150 mm) deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

### **3.8 UNAUTHORIZED EXCAVATION**

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi (17.2 MPa), may be used when approved by Architect.
  1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

### **3.9 STORAGE OF SOIL MATERIALS**

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
  1. Stockpile soil material away from edge of excavations.

### **3.10 BACKFILL**

- A. Place and compact backfill in excavations promptly, but not before completing the following:
  1. Construction below finish grade..

2. Testing and inspecting underground utilities.
3. Removing concrete formwork.
4. Removing trash and debris.
5. Removing temporary shoring and bracing, and sheeting.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

### **3.11 UTILITY TRENCH BACKFILL**

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Backfill voids with satisfactory soil while removing shoring and bracing.

1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

D. Place and compact final backfill of satisfactory soil to final subgrade elevation.

E. Install warning tape directly above utilities, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

### **3.12 SOIL FILL**

A. Scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:

1. Under gravel on top of footings, use satisfactory soil material.
2. Under walks and pavements, use satisfactory soil material.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

### **3.13 SAND FILL**

A. Compact drain bedding course to required cross sections and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

B. When compacted thickness of drainage course is 6 inches (150 mm) or less, place materials in a single layer.

C. When compacted thickness of drainage course exceeds 6 inches (150 mm), place materials in equal layers, with no layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick when compacted.

### **3.14 SOIL MOISTURE CONTROL**

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
  - 1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
  - 2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

### **3.15 COMPACTION OF SOIL BACKFILLS AND FILLS**

- A. Place backfill and fill soil materials in layers not more than 4 inches (100 mm) in loose depth for material compacted by hand-operated tampers or other light compaction equipment.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:
  - 1. Under walkways, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill soil material at 92 percent.
  - 2. Under gravel or unpaved areas, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill soil material at 95percent.
  - 3. For utility trenches, compact each layer of initial and final backfill soil material at 85 percent.

### **3.16 GRADING**

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
  - 1. Provide a smooth transition between adjacent existing grades and new grades.
  - 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
  - 1. Turf or Unpaved Areas: Plus or minus 1 inch (25 mm).
  - 2. Walks: Plus or minus 1 inch (25 mm)

### **3.17 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS**

- A. Place subbase course on subgrades free of mud, frost, snow, or ice.

### **3.18 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE**

- A. Place drainage course on subgrades free of mud, frost, snow, or ice.



- B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
  - 1. Place drainage course minimum 3 inches (75 mm) in compacted thickness in a single layer.
  - 2. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

### **3.19 FIELD QUALITY CONTROL**

- A. Special Inspections: Contractor will engage a qualified special inspector to perform the following special inspections:
  - 1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
  - 2. Determine that fill material and maximum lift thickness comply with requirements.
  - 3. Determine, at the required frequency, that in-place density of compacted fill complies with requirements.
- B. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.
- C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.
- D. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:
  - 1. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 100 feet (30 m) or less of wall length, but no fewer than two tests.
  - 2. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet (46 m) > or less of trench length, but no fewer than two tests.
- E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

### **3.20 PROTECTION**

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
  - 1. Scarify or remove and replace soil material to depth as directed by Engineer; reshape and recompact.

- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
  - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

### **3.21 DISPOSAL OF SURPLUS AND WASTE MATERIALS**

- A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.
- B. Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Architect.
  - 1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

**END OF SECTION 312000**