PROJECT MANUAL

Replace Fire Alarm System & Electrical Renovation

Bellefontaine Habilitation Center

Bellefontaine Neighbors, Missouri

Designed By: Rogers-Schmidt Engineering
1736 West Park Center Dr.
St. Louis, MO 63128

Date Issued: February 10, 2025

Project No.: M2006-01

STATE *of* MISSOURI

OFFICE *of* ADMINISTRATION

Facilities Management, Design and Construction

SECTION 000107A – PROFESSIONAL SEALS AND CERTIFICATIONS – ALL EXCEPT FIRE ALARM

PROJECT NUMBER: M2006-01

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

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:

All except Division 28

Expires 12/31/26
Barry D. Freiner, P.E.

END OF SECTION 000107A

SECTION 000107B - PROFESSIONAL SEALS AND CERTIFICATIONS - FIRE ALARM

PROJECT NUMBER: M2006-01

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

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Drawings:

FAD and FA Series

Specifications:

Division 28

Expires 12/31/25
Courtney R. Ogle, P.E.

END OF SECTION 000107B

ENGINEER OF RECORD:
COURTNEY R. OGLE, PE
LICENSE NO. PE-2015000584

CODE CONSULTANTS, INC.
2043 WOODLAND PKWY, SUITE 300
ST. LOUIS, MO 63146-4235
PHONE: 314-991-2633
CORPORATE CERTIFICATE OF AUTHORITY
NO. 000419

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SECTION 000115 – LIST OF DRAWINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract including General and Supplementary Conditions, Bid Form, and other Division 01 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:

	TITLE	SHEET #	DATE
1.	Cover Sheet	Sheet G-001	02-10-25
2.	Site Maps, Asset Numbers, Construction Phasing & Schedule	Sheet G-002	02-10-25
3.	Drawing Index	Sheet G-003	02-10-25
4.	Electrical Symbols, Abbreviations & General Notes	Sheet E-001	02-10-25
5.	Electrical Site Plan	Sheet ES-101	02-10-25
6.	12.47kV Campus Main Switchgear	Sheet ES-401	02-10-25
7.	Maintenance Building Electrical Demolition Plan	Sheet ED-401	02-10-25
8.	Physical Therapy Building Electrical Demolition Plan	Sheet ED-402	02-10-25
9.	Donnelly Building Electrical Demolition Plan	Sheet ED-403	02-10-25
10.	12.47kV One–Line Diagram – Demolition	Sheet ED-601	02-10-25
11.	Demolition One-Line Diagram – Maintenance Building	Sheet ED-602	02-10-25
12.	Demolition One-Line Diagram – Physical Therapy Building	Sheet ED-603	02-10-25
13.	Maintenance Building Electrical Plan	Sheet E-401	02-10-25
14.	Physical Therapy Building Electrical Plan	Sheet E-402	02-10-25
15.	Donnelly Building Electrical Plan	Sheet E-403	02-10-25
16.	Electrical Details	Sheet E-501	02-10-25
17.	12.47kV One–Line Diagram	Sheet E-601	02-10-25

	TITLE	SHEET #	DATE
18.	One-Line Diagram – Maintenance Building	Sheet E-602	02-10-25
19.	One-Line Diagram – Physical Therapy Building	Sheet E-603	02-10-25
20.	12.47kV Feeder & Equipment Schedules	Sheet E-604	02-10-25
21.	Fire Alarm Cover Sheet/Notes, Matrix, and Sheet Index	Sheet FA-001	02-10-25
22.	Site Fire Alarm Plan	Sheet FA-100	02-10-25
23.	Apartment A New Work Fire Alarm Plan	Sheet FA-101	02-10-25
24.	Apartment B New Work Fire Alarm Plan	Sheet FA-102	02-10-25
25.	Buildings 1601–1610, 1908, 1801–1810, 1901–1906 New Work Fire Alarm Plan	Sheet FA-103	02-10-25
26.	Warehouse/Food Distribution Center New Work Fire Alarm Plan	Sheet FA-104	02-10-25
27.	Maintenance Building New Work Fire Alarm Plan	Sheet FA-105	02-10-25
28.	Multipurpose Building New Work Fire Alarm Plan	Sheet FA-106	02-10-25
29.	Physical Therapy Building New Work Fire Alarm Plan	Sheet FA-107	02-10-25
30.	Apartment A Demolition Work Fire Alarm Plan	Sheet FAD-101	02-10-25
31.	Apartment B Demolition Work Fire Alarm Plan	Sheet FAD-102	02-10-25
32.	Buildings 1601–1610, 1908, 1801–1810, 1901–1906 Demolition Work Fire Alarm Plan	Sheet FAD-103	02-10-25
33.	Warehouse/Food Distribution Center Demolition Work Fire Alarm Plan	Sheet FAD-104	02-10-25
34.	Maintenance Building Demolition Work Fire Alarm Plan	Sheet FAD-105	02-10-25
35.	Multipurpose Building Demolition Work Fire Alarm Plan	Sheet FAD-106	02-10-25
36.	Physical Therapy Building Demolition Work Fire Alarm Plan	Sheet FAD-107	02-10-25
37.	Fire Alarm Details	Sheet FA-500	02-10-25
38.	Apartment A Matrix, CBE, Calculations and Riser Diagram	Sheet FA-601	02-10-25
39.	Apartment B Matrix, CBE, Calculations and Riser Diagram	Sheet FA-602	02-10-25
40.	Buildings 1601–1610, 1908 Matrix, CBE, Calculations and Riser Diagram	Sheet FA-603	02-10-25
41.	Buildings 1801–1810 Matrix, CBE, Calculations and Riser Diagram	Sheet FA-604	02-10-25
42.	Buildings 1901–1906 Matrix, CBE, Calculations and Riser Diagram	Sheet FA-605	02-10-25

	TITLE	SHEET #	DATE
43.	Warehouse/Food Distribution Center Matrix, CBE, Calculations and Riser Diagram	Sheet FA-606	02-10-25
44.	Maintenance Building Matrix, CBE, Calculations and Riser Diagram	Sheet FA-607	02-10-25
45.	Multipurpose/Physical Therapy Building Matrix, CBE, Calculations and Riser Diagram	Sheet FA-608	02-10-25

END OF SECTION 000115

SECTION 001116 - INVITATION FOR BID

1.0 OWNER:

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

2.0 PROJECT TITLE AND NUMBER:

A. Replace Fire Alarm System & Electrical Renovation
Bellefontaine Habilitation Center
Bellefontaine Neighbors, Missouri
Project No.: M2006-01

3.0 BIDS WILL BE RECEIVED:

A. Until: 1:30 PM, May 20, 2025

B. **Only electronic bids sent to FMDCBids@oa.mo.gov shall be accepted: (See Instructions to Bidders for further detail)**

4.0 DESCRIPTION:

A. Scope: The project includes the replacement/rearrangement of the existing 12.47kV electrical distribution equipment campus-wide and replacement of the fire alarm system in twenty-nine (29) of the thirty-five (35) existing buildings at the Bellefontaine Habilitation Center.

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.**

5.0 PRE-BID MEETING:

A. Place/Time**:** 10:00 AM, May 6, 2025, at Bellefontaine Habilitation Center - Maintenance Shop, 10695 Bellefontaine Road, Bellefontaine Neighbors, 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, Barry Freiner, (636) 600-1551, email: bfreiner@rogers-schmidt.com

B. Project Manager: Michael Schrader, (573) 536-7105, email: michael.schrader@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.

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 one (1) party may be limited in accordance with available supply.

B. For the convenience of contractors, subcontractors and suppliers, bidding documents are available on the Owner's website at 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 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 successful Bidder (contractor) to fulfill every detail of the requirements of the contract, nor accepted as a basis for any claims for extra compensation or time extension.

B. Under no circumstances will Bidders give their plans and specifications to other Bidders. It is highly encouraged, but not required, that all Bidders be on the official planholders list to receive project updates including but not limited to any addenda that are issued during the bidding process.

4.0 - INTERPRETATIONS

A. No Bidder shall be entitled to rely on oral or written representations from any person as to the meaning of the plans and specifications or the acceptability of alternate products, materials, form or type of construction.

B. Bidders shall make all requests for interpretations in writing and submit all requests to the Project Designer and Project Manager identified in Section 007300 – Supplementary Conditions with all necessary supporting documentation no less than five (5) working days before opening of bids. Responses to requests for interpretation will be issued via a written addendum and will be sent as promptly as is practicable to all official planholders and posted on the Owner's website. All such addenda shall become part of the bid and contract documents.

C. Bidders shall make all requests for an "Acceptable Substitution" on the Section 006325 Substitution Request Form. The request shall be emailed to the Project Designer and Project Manager identified in Section 007300 – Supplementary Conditions no less than five (5) working days before opening of bids. Responses to requests for substitutions will be issued via a written addendum and will be sent as promptly as is practicable to all official planholders and posted on the Owner's website. All such addenda shall become part of the bid and contract documents.

D. An "Acceptable Substitution" requested after the award of bid will only be approved if proven to the satisfaction of the Owner and the Designer 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 and all requests of this nature must be submitted in accordance with Article 3.1 of the General Conditions.

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 on the bid documents or the bid will be rejected for being non-responsive.

B. Depending on the specific project requirements, **the following is a GENERIC list** of all possible bid forms that may be due with bid submittals. Bidders must verify each specific project's requirements in Section 004113 to ensure they have provided all the required documentation with their submission.

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

C. The Bidder shall submit its bid on the forms provided by the Owner in the same file format (PDF) with each space fully and properly completed, typewritten or legibly printed, including all amounts required for alternate bids, unit prices, cost accounting data, etc. The Owner will reject bids that are not on the Owner's forms or that do not contain all requested information. All forms can be found on the Owner's website at https://oa.mo.gov/facilities/bid-opportunities/bid-listing-electronic-plans and shall be submitted with your bid to FMDCBids@oa.mo.gov.

D. All bids shall be submitted without additional terms and conditions, modifications, or reservations. The completed forms should not include interlineations, alterations, or erasures. Bids not in compliance with the requirements of this paragraph will be rejected as non-responsive.

E. 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 in the bid documents in Section 004113. Failure of the Bidder to submit the duly authorized bid bond or 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 bid closing or if the Bidder, within ten (10) working days after notification of award, refuses or is unable to 1) execute the tendered contract, 2) provide an acceptable performance and payment bond, or 3) provide evidence of required insurance coverage.

F. The bid bond 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.

6.0 - SIGNING OF BIDS

A. 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. If the Bidder is an entity organized in a state other than Missouri, the Bidder must provide a Certificate of Authority to do business in the State of Missouri.

B. If the successful Bidder is doing business in the State of Missouri under a fictitious name, the Bidder 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.

C. A bid from an individual shall be signed as noted on the Bid Form.

D. 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.

E. A bid from a limited liability company (LLC) shall be signed by a manager or a managing member of the LLC.

F. A bid from a corporation shall have the correct corporate name thereon and the signature of an authorized officer of the corporation. Title of office held by the person signing for the corporation shall appear, along with typed name of said individual and the corporate license number shall be provided. In addition, for corporate proposals, the President or Vice-President listed per the current filing with the Missouri Secretary of State should sign as the Bidder. If the signatory is other than the corporate president or vice president, the bidder must provide satisfactory evidence that the signatory has the legal authority to bind the corporation.

7.0 - RECEIVING BID SUBMITTALS

A. It is the Bidder's sole responsibility to ensure receipt of the bid submittals by Owner on or before the date and time specified in the Invitation for Bid or as modified via written addenda. Bids received after the date and time specified will not be considered by the Owner.

B. All bids shall be received via email at FMDCBids@oa.mo.gov and bids received by the Owner through any other means, including hard copies, will not be considered, and will be discarded by the Owner unopened.

8.0 - MODIFICATION AND WITHDRAWAL OF BIDS

A. Bidder may withdraw a bid at any time prior to the 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. Bidder may modify a bid until the scheduled closing time by sending a revised bid to FMDCBids@oa.mo.gov with a note in the subject line and body of the email that it is a revised bid. All revised bids must be submitted to FMDCBids@oa.mo.gov, revised bids sent any other way will not be considered.

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 limited to, contracts for the furnishing and installation of furniture, equipment, machinery, appliances and other apparatuses.

C. The Owner will award a contract to the lowest, responsive, and responsible Bidder in accordance with Section 8.250, RSMo. No contract will be awarded to any Bidder who has had a contract with the Owner terminated within the preceding twelve months for material breach of contract or who has been suspended or debarred by the Owner.

D. Award of alternates, if any, will be made in numerical order unless all bids received are such that the order of acceptance of alternates does not affect the determination of the lowest, responsive, responsible bidder.

E. No award shall be considered binding upon the Owner until the written contract has been properly executed and the following documentation has been provided: 1) performance and payment bond consistent with Article 6.1 of the General Conditions; 2) proof of the required insurance coverage; 3) an executed Section 004541 - Affidavit of Work Authorization form; and 4) documentation evidence enrollment and participation in a federal work authorization program.

F. Failure to execute and return the contract and associated documents within the prescribed period 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.

G. 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.

H. 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. 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.

I. The successful Bidder must be registered in MissouriBUYS powered by MOVERS at https://missouribuys.mo.gov/supplier-registration# as an approved vendor prior to being issued a contract.

10.0 - CONTRACT SECURITY

A. The successful Bidder shall furnish a performance/payment bond as set forth in General Conditions Article 6.1 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, manufacturer, or suppliers 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. 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 or if more than one subcontractor is listed for any category without designating the portion of work to be performed by each, 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 Bidder'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. 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 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 required to complete and submit the applicable portion of Section 004545 - Anti-Discrimination Against Israel Act Certification with its 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.

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 nonresponsive, and its bid shall be rejected.

2. The Bidder should submit with its bid all 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 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 Prime Bidder that qualifies as an SDVE shall receive a three-percentage 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 will become 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.

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.) 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 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 Equal Opportunity or by the Federal U.S. Small Business Administration directory.

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 Office of Equal Opportunity online SDVE directory at https://oeo.mo.gov/sdve-certification-program/ or the Federal U.S. Small Business Administration directory https://veterans.certify.sba.gov/#search.

3. Additional information, clarifications, or other information regarding the MBE/WBE/SDVE listings in the directories may be obtained by contacting 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 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 granted a waiver and will be considered 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;

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 in the 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 nonresponsive 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 the 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 in writing.

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
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.

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

ARTICLE 1. STATEMENT OF WORK

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

Project Name: **Replace Fire Alarm System &Electrical Renovation**
Bellefontaine Habilitation Center
Bellefontaine Neighbors, Missouri

Project Number: **M2006-01**

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 **390 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: $

Accepted Alternates, if applicable to the Project and accepted by the Owner.

TOTAL CONTRACT AMOUNT: ($CONTRACT AMOUNT)

UNIT PRICES: The Owner accepts the following Unit Prices:

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

ARTICLE 5. PREVAILING WAGE RATE

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

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

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

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

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

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

Total $

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

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

ARTICLE 7. CONTRACT DOCUMENTS

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

1. Division 0 – Procurement and Contracting Information, including, but not limited to:
    a. Invitation for Bid (Section 001116)
    b. Instructions to Bidders (Section 002113)
    c. Supplementary Instructions to Bidders (if applicable) (Section 002213)
    d. The following documents as completed and executed by the Contractor and accepted by the Owner, if applicable:
        i. Bid Form (Section 004113)
        ii. 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), if applicable
    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), if applicable
    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.

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

Bond No._____

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

REASON FOR SUBSTITUTION

DOES PROPOSED SUBSTITUTION AFFECT OTHER PARTS OF WORK?

☐ YES ☐ NO

IF YES, EXPLAIN

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

☐ YES ☐ NO

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

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

BIDDER/CONTRACTOR	DATE

REVIEW AND ACTION

☐ Resubmit Substitution Request with the following additional information:

☐ Substitution is accepted.

☐ Substitution is accepted with the following comments:

☐ 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

PAY APP NO.	PROJECT NUMBER
CHECK IF FINAL ☐**FINAL**	DATE

MBE/WBE/SDVE PROGRESS REPORT

Remit with **ALL** Progress and Final Payments

(Please check appropriate box) ☐CONSULTANT ☐CONSTRUCTION

PROJECT TITLE	
PROJECT LOCATION	
FIRM	
ORIGINAL CONTRACT SUM (Same as Line Item 1. on Form A of Application for Payment) **$**	TOTAL CONTRACT SUM TO DATE (Same as Line Item 3. on Form A of Application for Payment) **$**

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

SELECT MBE, WBE, SDVE	ORIGINAL CONTRACT PARTICIPATION AMOUNT	PARTICIPATION AMOUNT PAID-TO-DATE (includes approved contract changes)	CONSULTANT/SUBCONSULTANT OR CONTRACTOR/SUBCONTRACTOR/SUPPLIER COMPANY NAME
☐ MBE ☐ WBE ☐ SDVE	$	$	
☐ MBE ☐ WBE ☐ SDVE	$	$	
☐ MBE ☐ WBE ☐ SDVE	$	$	
☐ MBE ☐ WBE ☐ SDVE	$	$	
☐ MBE ☐ WBE ☐ SDVE	$	$	
☐ MBE ☐ WBE ☐ SDVE	$	$	

Revised 06/2023

INSTRUCTIONS FOR MBE/WBE/SDVE PROGRESS REPORT

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

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

At Initial Pay Application fill in the following:

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

For all subsequent Pay Applications fill in the following:

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

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

PROJECT NUMBER

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 EMBOSSER 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

A. These General Conditions apply to each section of these specifications. The Contractor is subject to the provisions contained herein.

B. The General Conditions are intended to define the relationship of the Owner, the Designer and the Contractor thereby establishing certain rules and provisions governing the operation and performance of the work so that the work may be performed in a safe, orderly, expeditious and workmanlike manner.

ARTICLE 1 – GENERAL PROVISIONS

ARTICLE 1.1 - DEFINITIONS

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

1. **"COMMISSIONER":** The Commissioner of the Office of Administration.
2. **"CONSTRUCTION DOCUMENTS":** The "Construction Documents" shall consist of the Project Manual, Drawings and Addenda.
3. **"CONSTRUCTION REPRESENTATIVE:"** Whenever the term "Construction Representative" is used, it shall mean the Owner's Representative at the work site.
4. **"CONTRACTOR"**: Party or parties who have entered into a contract with the Owner to furnish work under these specifications and drawings.
5. **"DESIGNER"**: When the term "Designer" is used herein, it shall refer to the Architect, Engineer, or Consultant of Record specified and defined in Paragraph 2.0 of the Supplemental Conditions, or his duly authorized representative. The Designer may be either a consultant or state employee.
6. **"DIRECTOR"**: Whenever the term "Director" is used, it shall mean the Director of the Division of Facilities Management, Design and Construction or his Designee, representing the Office of Administration, State of Missouri. The Director is the agent of the Owner.
7. **"DIVISION":** Shall mean the Division of Facilities Management, Design and Construction, State of Missouri.
8. **"INCIDENTAL JOB BURDENS":** Shall mean those expenses relating to the cost of work, incurred either in the home office or on the job-site, which are necessary in the course of doing business but are incidental to the job. Such costs include office supplies and equipment, postage, courier services, telephone expenses including long distance, water and ice and other similar expenses.
9. **"JOINT VENTURE"**: An association of two (2) or more businesses to carry out a single business enterprise for profit for which purpose they combine their property, capital, efforts, skills and knowledge.
10. **"OWNER"**: Whenever the term "Owner" is used, it shall mean the State of Missouri. Acting by and through the Office of Administration, Division of Facilities Management, Design and Construction.
11. **"PROJECT"**: Wherever the term "Project" is used, it shall mean the work required to be completed by the construction contract.
12. **"PROJECT MANUAL"**: The "Project Manual" shall consist of Introductory Information, Invitation for Bid, Instructions to Bidders, Bid Documents, Additional Information, Standard Forms, General Conditions, Supplemental General Conditions, General Requirements and Technical Specifications.
13. **"SUBCONTRACTOR"**: Party or parties who contract under, or for the performance of part or this entire Contract between the Owner and Contractor. The subcontract may or may not be direct with the Contractor.
14. **"WORK"**: All supervision, labor, materials, tools, supplies, equipment, and any incidental operations and/or activities required by or reasonably inferable from the Contract Documents necessary to construct the Project and to produce the results intended by the Contract Documents in a safe, expeditious, orderly, and workmanlike manner 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 ensure 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 under this clause to any labor union with which they have bargaining or other agreements.

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

ARTICLE 1.5 - ANTI-KICKBACK

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

ARTICLE 1.6 - PATENTS AND ROYALTIES

A. The Contractor shall hold and save the Owner and its officers, agents, servants, and employees harmless from liabilities of any nature or kind, including cost and expenses, for, or on account of, any patented or unpatented invention, process, article or appliance manufactured or used in the performance of this contract, including its use by the Owner, unless otherwise specifically stipulated in the contract documents.

B. If the Contractor uses any design, device or materials covered by letters, patent or copyright, the Contractor shall provide for such use by suitable agreement with the Owner of such patented or copyrighted design, device or material. It is mutually agreed and understood, without exception, that the contract prices shall include all royalties or costs arising from the use of such design, device or materials, in any way involved in the work. The Contractor and/or his sureties shall indemnify and save harmless the Owner of the project from any and all claims for infringement by reason of the use of such patented or copyrighted design, device or materials or any trademark or copyright in connection with work agreed to be performed under this contract and shall indemnify the Owner for any cost, expense or damage it may be obliged to pay by reason of such infringement at any time during the prosecution of the work or after completion of the work.

ARTICLE 1.7 - PREFERENCE FOR AMERICAN AND MISSOURI PRODUCTS AND SERVICES

A. By virtue of statutory authority a preference will be given to Missouri labor and to products of mines, forests and quarries of the state of Missouri when they are found in marketable quantities in the state, and all such materials shall be of the best quality and suitable character that can be obtained at reasonable market prices, all as provided for in Section 8.280, Missouri Revised Statutes and Cumulative Supplements.

B. Furthermore, pursuant to Section 34.076 Missouri Revised Statutes and Cumulative Supplements, a preference shall be given to those persons doing business as Missouri firms, corporations, or individuals, or which maintain Missouri offices or places of business, when the quality of performance promised is equal or better and the price quoted is the same or less. In addition, in order for a non-domiciliary bidder to be successful, his bid must be that same percentage lower than a domiciliary Missouri bidder's bid, as would be required for a Missouri bidder to successfully bid in the non-domiciliary state.

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

ARTICLE 1.8 - COMMUNICATIONS

A. All notices, requests, instructions, approvals, and claims must be in writing and shall be delivered to the Designer and copied to the Construction Representative for the project except as required by Article 1.12 Disputes and Disagreements, or as otherwise specified by the Owner in writing as stated in Section 012600. Any such notice shall be deemed to have been given as of the time of actual receipt.

B. The Contractor shall attend on-site progress and coordination meetings, as scheduled by the Construction Representative, no less than once a month.

C. The Contractor shall ensure that major subcontractors and suppliers shall attend monthly progress meetings as necessary to coordinate the work, and as specifically requested by the Construction Representative.

ARTICLE 1.9 - SEPARATE CONTRACTS AND COOPERATION

A. The Owner reserves the right to let other contracts in connection with this work. The Contractor shall afford other contractors reasonable opportunity for the introduction and storage of their materials and the execution of their work and shall properly connect and coordinate his work with theirs.

B. The Contractor shall consult the drawings for all other contractors in connection with this work. Any work conflicting with the above shall be brought to the attention of the Owner’s Representative before the work is performed. If the Contractor fails to do this, and constructs any work which interferes with the work of another contractor, the Contractor shall remove any part so conflicting and rebuild same, as directed by the Owner’s Representative at no additional cost to the Owner.

C. Each contractor shall be required to coordinate his work with other contractors so as to afford others reasonable opportunity for execution of their work. No contractor shall delay any other contractor by neglecting to perform contract work at the proper time. If any contractor causes delay to another, they shall be liable directly to that contractor for such delay in addition to any liquidated damages which might be due the Owner.

D. Should the Contractor or project associated subcontractors refuse to cooperate with the instructions and reasonable requests of other Contractors or other subcontractors in the overall coordinating of the work, the Owner may take such appropriate action and issue directions, as required, to avoid unnecessary and unwarranted delays.

E. Each Contractor shall be responsible for damage done to Owner's or other Contractor's property by him/her or workers in his employ through their fault or negligence.

F. Should a Contractor sustain any damage through any act or omission of any other Contractor having a contract with the Owner, the Contractor so damaged shall have no claim or cause of action against the Owner for such damage, but shall have a claim or cause of action against the other Contractor to recover any and all damages sustained by reason of the acts or omissions of such Contractor. The phrase "acts or omissions" as used in this section shall be defined to include, but

not be limited to, any unreasonable delay on the part of any such contractors.

ARTICLE 1.10 - ASSIGNMENT OF CONTRACT

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

ARTICLE 1.11 - INDEMNIFICATION

A. Contractor agrees to indemnify and save harmless Owner and its respective commissioners, officers, officials, agents, consultants and employees and Designer, their agents, servants and employees, from and against any and all liability for damage arising from injuries to persons or damage to property occasioned by any acts or omissions of Contractor, any subcontractors, agents, servants or employees, including any and all expense, legal or otherwise, which may be incurred by Owner or Designer, its agents, servants or employees, in defense of any claim, action or suit.

B. The obligations of the Contractor under this paragraph shall not extend to the liability of the Designer, his agents or employees, arising out of (1) the preparation or approval of maps, drawings, opinions, reports, surveys, contract changes, design or specifications, or (2) giving of or the failure to give directions or instructions by the Designer, his agents or employees as required by this contract documents provided such giving or failure to give is the primary cause of the injury or damage.

ARTICLE 1.12 - DISPUTES AND DISAGREEMENTS

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

ARTICLE 2 -- OWNER/DESIGNER RESPONSIBILITIES

A. The Owner shall give all orders and directions contemplated under this contract relative to the execution of the work. During progress of work the Owner will be represented at the project site by the Construction Representative and/or Designer, whose responsibilities are to see that this contract is properly fulfilled.

B. The Owner shall at all times have access to the work whenever it is in preparation or progress. The Contractors shall provide proper facilities for such access and for inspection and supervision.

C. All materials and workmanship used in the work shall be subject to the inspection of the Designer and Construction Representative, and any work which is deemed defective shall be removed, rebuilt or made good immediately upon notice. The cost of such correction shall be borne by the Contractor. Contractor shall not be entitled to an extension of the contract completion date in order to remedy defective work. All rejected materials shall be immediately removed from the site of the work.

D. If the Contractor fails to proceed at once with the correction of rejected defective materials or workmanship, the Owner may, by separate contract or otherwise, have the defects remedied or rejected. Materials removed from the site and charge the cost of the same against any monies which may be due the Contractor, without prejudice to any other rights or remedies of the Owner.

E. Failure or neglect on the part of Owner to observe faulty work, or work done which is not in accordance with the drawings and specifications shall not relieve the Contractor from responsibility for correcting such work without additional compensation.

F. The Owner shall have the right to direct the Contractor to uncover any completed work.

1. If the Contractor fails to adequately notify the Construction Representative and/or Designer of an inspection as required by the Contract Documents, the Contractor shall, upon written request, uncover the work. The Contractor shall bear all costs associated with uncovering and again covering the work exposed.

2. If the Contractor is directed to uncover work, which was not otherwise required by the Contract Documents to be inspected, and the work is found to be defective in any respect, no compensation shall be allowed for this work. If, however, such work is found to meet

the requirements of this contract, the actual cost of labor and material necessarily involved in the examination and replacement plus 10% shall be allowed the Contractor.

G. The Designer shall give all orders and directions contemplated under this contract relative to the scope of the work and shall give the initial interpretation of the contract documents.

H. The Owner may file a written notice to the Contractor to dismiss immediately any subcontractors, project managers, superintendents, foremen, workers, watchmen or other employees whom the Owner may deem incompetent, careless or a hindrance to proper or timely execution of the work. The Contractor shall comply with such notice as promptly as practicable without detriment to the work or its progress.

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

ARTICLE 3 -- CONTRACTOR RESPONSIBILITIES

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

ARTICLE 3.1 -- ACCEPTABLE SUBSTITUTIONS

A. The Contractor may request use of any article, device, product, material, fixture, form or type of construction which in the judgment of the Owner and Designer is equal in all respects to that named. Standard products of manufacturers other than those specified will be accepted when, prior to the ordering or use thereof, it is proven to the satisfaction of the Owner and Designer that they are equal in design, strength, durability, usefulness and convenience for the purpose intended.

B. Any changes required in the details and dimensions indicated on the drawings for the substitution of products other than those specified shall be properly made at the expense of the Contractor requesting the substitution or change.

C. The Contractor shall submit a request for such substitutions in writing to the Owner and Designer within twenty (20) working days after the date of the "Notice to Proceed." Thereafter no consideration will be given to alternate forms of accomplishing the work. This Article does not preclude the Owner from exercising the provisions of Article 4 hereof.

D. Any request for substitution by the Contractor shall be submitted in accordance with SECTION 002113 - INSTRUCTIONS TO BIDDERS.

E. When a material has been approved, no change in brand or make will be permitted unless:

1. Written verification is received from the manufacturer stating they cannot make delivery on the date previously agreed, or
2. Material delivered fails to comply with contract requirements.

ARTICLE 3.2 -- SUBMITTALS

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

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

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

B. All subcontractors' shop drawings and schedules shall be submitted by the Contractor and shall bear evidence that Contractor has received, reviewed, and approved them. Any shop drawings and schedules submitted without this evidence will be returned to the Contractor for resubmission.

C. The Contractor shall include with the shop drawing, a letter indicating any and all deviations from the drawings and/or specifications. Failure to notify the Designer of such deviations will be grounds for subsequent rejection of the related work or materials. If, in the opinion of the Designer, the deviations are not acceptable, the Contractor will be required to furnish the item as specified and indicated on the drawings.

D. The Designer shall check shop drawings and schedules with reasonable promptness and approve them only if they conform to the design concept of the project and comply with the information given in the contract documents. The approval shall not relieve the Contractor from the responsibility to comply with the drawings and specifications, unless the Contractor has called the Designer's attention to the deviation, in writing, at the time of

submission and the Designer has knowingly approved thereof. An approval of any such modification will be given only under the following conditions:

1. It is in the best interest of the Owner
2. It does not increase the contract sum and/or completion time
3. It does not deviate from the design intent
4. It is without prejudice to any and all rights under the surety bond.

E. No extension of time will be granted because of the Contractor's failure to submit shop drawings and schedules in ample time to allow for review, possible resubmission, and approval. Fabrication of work shall not commence until the Contractor has received approval. The Contractor shall furnish prints of approved shop drawings and schedules to all subcontractors whose work is in any way related to the work under this contract. Only prints bearing this approval will be allowed on the site of construction

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

ARTICLE 3.3 – AS-BUILT DRAWINGS

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

ARTICLE 3.4 – GUARANTY AND WARRANTIES

A. General Guaranty

1. Neither the final certificate of payment nor any provision in the contract documents nor partial use or occupancy of the premises by the Owner shall constitute an acceptance of work not done in accordance with contract requirements.
2. The Contractor or surety shall remedy any defects in the work and pay for any damage to property resulting there from which shall appear within a period of one (1) year from the date of substantial completion unless a longer period is otherwise specified or a differing guaranty period has been established in the substantial completion certificate. The Owner will give notice of observed defects with reasonable promptness.
3. In case of default on the part of the Contractor in fulfilling this part of this contract, the Owner may correct the work or repair the damage and the cost and expense incurred in such event shall be paid by or recoverable from the Contractor or surety.
4. The work will be free from defects not inherent in the quality required or permitted, and that the Work will conform to the requirements of the Contract Documents. Work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective. The Contractor's guaranty excludes remedy for damage or defect caused by abuse, modifications not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear under normal usage. If required by the Owner, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment

B. Extended Warranty

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

ARTICLE 3.5 -- OPERATION AND MAINTENANCE MANUALS

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

1. Start-up and Shut-down Procedures: Provide a step-by-step write up of all major equipment. When manufacturer’s printed start-up, trouble shooting and shut-down procedures are available; they may be incorporated into the operating manual for reference.

2. Operating Instructions: Written operating instructions shall be included for the efficient and safe operation of all equipment.

3. Equipment List: List of all major equipment as installed shall be prepared to include model number, capacities, flow rate, name place data, shop drawings and air and water balance reports.

4. Service Instructions: Provide the following information for all pieces of equipment.

    a. Recommended spare parts including catalog number and name of local supplier or factory representative.

    b. Belt sizes, types, and lengths.

    c. Wiring diagrams.

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

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

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

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

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

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

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

ARTICLE 3.6 – OTHER CONTRACTOR RESPONSIBILITIES

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

B. Contractor shall, at all times, enforce strict discipline and good order among his employees, and shall not employ on the work any unfit person or anyone not skilled in the work assigned to him/her.

C. The Contractor shall supply sufficient labor, material, plant and equipment and pay when due any laborer, subcontractor or supplier for supplies furnished and otherwise prosecute the work with diligence to prevent work stoppage and ensure completion thereof within the time specified.

D. The Contractor and each of his subcontractors shall submit to the Construction Representative, through the Designer such schedules of quantities and costs, progress schedules, payrolls, reports, estimates, records and other data as the Owner may request concerning work performed or to be performed under this contract.

E. The Contractor, subcontractors, and material suppliers shall upon written request, give the Owner access to all time cards, material invoices, payrolls, estimates, profit and loss statements, and all other direct or indirect costs related to this work.

F. The Contractor shall be responsible for laying out all contract work such as layout of architectural, structural, mechanical and electrical work, which shall be coordinated with layouts of subcontractors for general construction work. The Contractor is also responsible for unloading, uncrating and handling of all materials and equipment to be erected or placed by him/her, whether furnished by Contractor or others. No extra charges or compensation will be allowed as a result of failure to verify dimensions before ordering materials or fabricating items.

G. The Contractor must notify the Construction Representative at least one working day before placing concrete or burying underground utilities, pipelines, etc.

H. Contractors shall prearrange time with the Construction Representative for the interruption of any facility operation. Unless otherwise specified in these documents, all connections, alterations or relocations as well as all other portions of the work will be performed during normal working hours.

I. The Contractor shall coordinate all work so there will not be prolonged interruptions of existing equipment operation. Any existing plumbing, heating, ventilating, air conditioning or electrical disconnections necessary for the project, which affect portions of this construction or building or any other building must be scheduled with the Construction Representative to minimize or avoid any disruption of facility operations. In no case, unless previously approved in writing by the Construction Representative, shall utilities be left disconnected at the end of a work day or over a weekend. Any interruption of utilities either intentionally or accidentally shall not relieve the Contractor responsible for the interruption from the responsibility to repair and restore the utility to normal service. Repairs and restoration shall be made before the workers responsible for the repair and restoration leave the job.

J. Contractors shall limit operations and storage of materials to the area within the project, except as necessary to connect to existing utilities, and shall not encroach on neighboring property. The Contractor shall be responsible for repair of their damage to property on or off the project site occurring during construction of project. All such repairs shall be made to the satisfaction of the property owner.

K. Unless otherwise permitted, all materials shall be new and both workmanship and materials shall be of the best quality.

L. Unless otherwise provided and stipulated within these specifications, the Contractor shall furnish, construct, and/or install and pay for materials, devices, mechanisms, equipment, all necessary personnel, utilities including, but not limited to water, heat, light and electric power, transportation services, applicable taxes of every nature, and all other facilities necessary for the proper execution and completion of the work.

M. Contractor shall carefully examine the plans and drawings and shall be responsible for the proper fitting of his material, equipment and apparatus into the building.

N. The Contractor or subcontractors shall not overload, or permit others to overload, any part of any structure during the performance of this contract.

O. All temporary shoring, bracing, etc., required for the removal of existing work and/or for the installation of new work shall be included in this contract. The Contractor shall make good, at no cost to the Owner, any damage caused by improper support or failure of shoring in any respect. Each Contractor shall be responsible for shoring required to protect his work or adjacent property and improvements of Owner and shall be responsible for shoring or for giving written notice to adjacent property owners. Shoring shall be removed only after completion of permanent supports.

P. The Contractor shall provide at the proper time such material as is required for support of the work. If openings are required, whether shown on drawings or not, the Contractor shall see that they are properly constructed.

Q. During the performance of work the Contractor shall be responsible for providing and maintaining warning signs, lights, signal devices, barricades, guard rails, fences and other devices appropriately located on site which will give proper and understandable warning to all persons of danger of entry onto land, structure or equipment.

R. The Contractor shall be responsible for protection, including weather protection, and proper maintenance of all equipment and materials.

S. The Contractor shall be responsible for care of the finished work and shall protect same from damage or defacement until substantial completion by the Owner. If the work is damaged by any cause, the Contractor shall immediately begin to make repairs in accordance with the drawings and specifications. Contractor shall be liable for all damage or loss unless attributable to the acts or omissions of the Owner or Designer. Any claim for reimbursement shall be submitted in accordance with Article 4. After substantial completion the Contractor will only be responsible for damage resulting from acts or omissions of the Contractor or subcontractors through final warranty.

T. In the event the Contractor encounters an unforeseen hazardous material, the Contractor shall immediately stop work in the area affected and report the condition to the Owner and Designer in writing. The Contractor shall not be required, pursuant to Article 4, to perform, any work relating to hazardous materials.

U. In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency shall be determined as provided in Article 4.

V. Before commencing work, Contractors shall confer with the Construction Representative and facility representative and review any facility rules and regulations which may affect the conduct of the work.

W. Project signs will only be erected on major projects and only as described in the specifications. If no sign is specified, none shall be erected.

ARTICLE 3.7 -- SUBCONTRACTS

A. Subcontractor assignments as identified in the bid form shall not be changed without written approval of the Owner. The Owner will not approve changes of a listed subcontractor unless the Contractor documents, to the satisfaction of the Owner that the subcontractor cannot or will not perform the work as specified.

B. The Contractor is fully responsible to the Owner for the acts and omissions of all subcontractors and of persons either directly or indirectly employed by them.

C. Every subcontractor shall be bound by the applicable terms and provisions of these contract documents, but no contractual relationship shall exist between any subcontractor and the Owner unless the right of the Contractor to proceed with the work is suspended or this contract is terminated as herein provided, and the Owner in writing elects to assume the subcontract.

D. The Contractor shall upon receipt of "Notice to Proceed" and prior to submission of the first payment request, notify the Designer and Construction Representative in writing of the names of any subcontractors to be used in addition to those identified in the bid form and all major material suppliers proposed for all parts of the work.

ARTICLE 4 -- CHANGES IN THE WORK

4.1 CHANGES IN THE WORK

A. The Construction Representative, without giving notice to the surety and without invalidating this contract, may order extra work or make changes by altering, adding to or deducting from the work, this contract sum being adjusted accordingly. All such work shall be executed under the conditions of the original contract. A claim for extension of time caused by any change must be adjusted at the time of ordering such change. No future request for time will be considered.

B. Each Contract Change shall include all costs required to perform the work including all labor, material, equipment, overheads and profit, delay, disruptions, or other miscellaneous expenses. No subsequent requests for additional compensation including claims for delay, disruption, or reduced efficiency as a result of each change will be considered. Values from the Schedule of Values will not be binding as a basis for additions to or deductions from the contract price.

C. The amount of any adjustment in this contract price for authorized changes shall be agreed upon before such changes become effective and shall be determined, through submission of a request for proposal, as follows:

1. By an acceptable fixed price proposal from the Contractor. Breakdowns shall include all takeoff sheets of each Contractor and subcontractor. Breakdown shall include a listing of each item of material with unit prices and number of hours of labor for each task. Labor costs per hour shall be included with labor burden identified, which shall be not less than the prevailing wage rate, etc. Overhead and profit shall be shown separately for each subcontractor and the Contractor.

2. By a cost-plus-fixed-fee (time and material) basis with maximum price, total cost not to exceed said maximum. Breakdown shall include a listing of each item of material with unit prices and number of hours of labor for each task. Labor costs per hour shall be included with labor burden identified, which shall be not less than the prevailing wage rate, etc. Overhead and profit shall be shown separately for each subcontractor and the Contractor.

3. By unit prices contained in Contractor's original bid form and incorporated in the construction contract.

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

1. The overhead and profit charge by the Contractor and all subcontractors shall be considered to include, but is not limited to: incidental job burdens, small truck (under 1 ton) expense, mileage, small hand tools, warranty costs, company benefits and general office overhead. Project supervision including field supervision and job site office expense shall be considered a part of overhead and profit unless a compensable time extension is granted.

2. The percentages for overhead and profit charged on Contract Changes shall be subject to the following limits: (a) the percentage mark-up for the Contractor shall be limited to the Contractor’s fee: (b) fifteen percent (15%) maximum for Work directly performed by employees of a subcontractor, or sub-subcontractor; (c) five percent (5%) maximum for the Work performed or passed through to the Owner by the Contractor; (d) five percent (5%) maximum subcontractor’s mark-up for

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

3. The Contractor will be allowed to add the cost of Contractor's payment and performance bonding, builder's risk insurance, and general liability insurance to their cost of work. The above listed bonding and insurance cost shall not exceed two percent (2%) and shall be allowed on the total cost of the added work, including overhead and profit.

4. On proposals covering both increases and decreases in the amount of this contract, the application of overhead and profit shall be on the net change in the cost of the work.

5. The percentage(s) for overhead and profit to be credited to the Owner on Contract Changes that are solely decreases in the quantity of work or materials shall be the same as those for additive Contract Changes provided above.

E. No claim for an addition to this contract sum shall be valid unless authorized as aforesaid in writing by the Owner. In the event that none of the foregoing methods are agreed upon, the Owner may order the Contractor to perform work on a time and material basis. The cost of such work shall be determined by the Contractor's actual labor and material cost to perform the work plus overhead and profit as outlined herein. The Designer and Construction Representative shall approve the Contractor's daily time and material invoices for the work involved.

F. If the Contractor claims that any instructions involve extra cost under this contract, the Contractor shall give the Owner's Representative written notice thereof within a reasonable time after the receipt of such instructions, and in any event before proceeding to execute the work. No such claim shall be valid unless so made and authorized by the Owner, in writing.

G. In an emergency affecting the safety of life or of the structure or of adjoining property, the Contractor, without special instruction or authorization from the Construction Representative, is hereby permitted to act at their discretion to prevent such threatened loss or injury. The Contractor shall submit a claim for compensation for such emergency work in writing to the Owner's Representative.

ARTICLE 4.2 – CHANGES IN COMPLETION TIME

A. Extension of the number of work days stipulated in the Contract for completion of the work with compensation may be made when:

1. The contractor documents that proposed Changes in the work, as provided in Article 4.1, extends construction activities critical to contract completion date, OR

2. The Owner suspends all work for convenience of the Owner as provided in Article 7.3, OR

3. An Owner caused delay extends construction activities critical to contract completion (except as provided elsewhere in these General Conditions). The Contractor is to review the work activities yet to begin and evaluate the possibility of rescheduling the work to minimize the overall project delay.

B. Extension of the number of work days stipulated in the Contract for completion of the work <u>without</u> 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.

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 contact 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:

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Project Manager:

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Contract Specialist:

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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 1 complete sets of drawings and specifications at no charge.

B. The Owner will furnish the Contractor with approximately 1 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. 31

Section 100
ST. LOUIS COUNTY

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

Original Signed by
Todd Smith, Director
Division of Labor Standards

Filed With Secretary of State: **March 8, 2024**

Last Date Objections May Be Filed: **April 8, 2024**

Prepared by Missouri Department of Labor and Industrial Relations

OCCUPATIONAL TITLE	**Prevailing Hourly Rate
Asbestos Worker	$67.80
Boilermaker	$42.03*
Bricklayer-Stone Mason	$62.04
Carpenter	$64.31
Lather	
Linoleum Layer	
Millwright	
Pile Driver	
Cement Mason	$57.86
Plasterer	
Communication Technician	$62.59
Electrician (Inside Wireman)	$75.44
Electrician Outside Lineman	$42.03*
Lineman Operator	
Lineman - Tree Trimmer	
Groundman	
Groundman - Tree Trimmer	
Elevator Constructor	$42.03*
Glazier	$66.98
Ironworker	$70.24
Laborer	$53.79
General Laborer	
First Semi-Skilled	
Second Semi-Skilled	
Mason	$57.61
Marble Mason	
Marble Finisher	
Terrazzo Worker	
Terrazzo Finisher	
Tile Setter	
Tile Finisher	
Operating Engineer	$69.55
Group I	
Group II	
Group III	
Group III-A	
Group IV	
Group V	
Painter	$54.63
Plumber	$77.88
Pipe Fitter	
Roofer	$57.83
Sheet Metal Worker	$73.78
Sprinkler Fitter	$82.11
Truck Driver	$42.03*
Truck Control Service Driver	
Group I	
Group II	
Group III	
Group IV	

*The Division of Labor Standards received fewer than 1,000 reportable hours for this occupational title. The public works contracting minimum wage is established for this occupational title using data provided by Missouri Economic Research and Information Center.
**The Prevailing Hourly Rate includes any applicable fringe benefit amounts for each occupational title as defined in RSMo Section 290.210.

OCCUPATIONAL TITLE	**Prevailing Hourly Rate
Carpenter	$64.02
Millwright	
Pile Driver	
Electrician (Outside Lineman)	$78.52
Lineman Operator	
Lineman - Tree Trimmer	
Groundman	
Groundman - Tree Trimmer	
Laborer	$54.45
General Laborer	
Skilled Laborer	
Operating Engineer	$70.83
Group I	
Group II	
Group III	
Group IV	
Truck Driver	$50.95
Truck Control Service Driver	
Group I	
Group II	
Group III	
Group IV	

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

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

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

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

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

OVERTIME
and
HOLIDAYS

OVERTIME

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

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

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

HOLIDAYS

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

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

SECTION 011000 – SUMMARY OF WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 WORK COVERED BY CONTRACT DOCUMENTS

A. The Project consists of replacement/rearrangement of existing 12.47kV electrical distribution equipment campus wide and replacement of the existing fire alarm system in twenty-nine (29) of the thirty-five (35) existing buildings at the Bellefontaine Habilitation Center.

1. Project Location: 10695 Bellefontaine Road, St. Louis, Missouri 63137.

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 February 10, 2025, 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 primarily of 12.47kV electrical equipment replacements /rearrangements and building fire alarm system replacements:

1. The Work includes, but is not limited to:

a. Demolition of ten (10) existing 12.47kV pad-mount distribution switchgear units. Power fuses from demolished equipment are to be turned over to the Owner.

b. Relocation of one (1) existing 12.47kV pad-mount distribution switchgear unit to the location of one of the removed pad-mount switchgear units.

c. Splicing of underground 12.47kV cables in existing handholes and manholes at the location of two (2) of the removed pad-mount switchgear units and at the original location of the relocated pad-mount switchgear units.

d. Installation of a 12.47kV pad-mount sectionalizing cabinet at the location of four (4) of the removed pad-mount switchgear units.

e. Installation of a new 12.47 kV pad-mount distribution switchgear unit at the location of three (3) of the removed pad-mount switchgear units.

f. Update the existing protective device coordination and arc flash risk assessment study dated September 18, 2018, including arc flash hazard warning labeling of all new and relabeling of existing electrical equipment, if/as required, throughout the facility.

g. Preventative maintenance service on the existing main campus 12.47kV outdoor, walk-in protected aisle switchgear and replacement of the switchgear 48VDC battery system.

h. Replacement of the existing 300kVA indoor, dry-type distribution transformer that presently serves the Maintenance Building and the associated 208Y/120V-3PH-4W main distribution panelboard with a new 150kVA indoor, dry-type distribution transformer, 600A/3P, 208V enclosed main circuit breaker and 600A main lug, 208Y/120V-3PH-4W main distribution panelboard.

i. Replacement of the 208Y/120V electrical distribution equipment in the Physical Therapy mechanical/electrical room adjacent to the therapeutic pool.

j. Replacement of the existing mineral oil filled, pad-mount distribution transformer that presently serves the Donnelly Building with a less-flammable fluid filled, pad-mount distribution transformer and replacement of the 12.47kV cables serving the primary of this transformer.

k. Replacement of the fire alarm system in twenty-nine (29) of the thirty-five (35) existing buildings on campus.

D. The Work will be constructed under a single prime contract.

1.3 WORK UNDER OTHER CONTRACTS

A. Separate Contract: The Owner has awarded a separate contract for performance of certain construction operations at the site. Those operations will be conducted simultaneously with work under this contract. That Contract includes the following:

1. Contract: A separate contract has been awarded to Airco Service Company, 3131 Starlight Lane, Edwardsville, IL 62025 under MO OA FMDC Project No. M2307-01 to remove steam boilers, steam water distribution and various HVAC components and provide new heating water boilers, heating water distribution and various HVAC components for the Warehouse Building, Maintenance Building, Multipurpose Building and Physical Therapy Building. The work also includes removing an existing domestic hot water heating system including steam heat exchanger, storage tank, pump and piping in the Multipurpose Building and providing a new domestic water heater, pump and piping.

B. Cooperate fully with separate contractors so that work under those contracts may be carried out smoothly, without interfering with or delaying work under this Contract.

1.4 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-002 – Site Maps, Asset Numbers, Construction Phasing & Schedule.

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.

1.5 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 Existing Buildings: Maintain the existing buildings 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.

1.6 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 buildings 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 buildings.

3. Upon occupancy, the Owner will assume responsibility for maintenance and custodial service for occupied portions of the buildings.

1.7 MISCELLANEOUS PROVISIONS

A. Submit all shop drawings in a timely fashion and expedite those for especially long lead items such as the pad-mounted, liquid-filled, medium-voltage transformer.

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 012200 – UNIT PRICES

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.

B. Quantities of Units to be included in the Base Bid are indicated in Section 004322 – Unit Prices Form.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for Unit Prices.

B. Related Sections include the following:

1. First Division 1 Section below contains requirements that relate directly to Unit Prices.
2. Division 1 Section 012600 "Contract Modification Procedures" for procedures for submitting and handling Contract Changes.

1.3 DEFINITIONS

A. Unit Price is an amount proposed by bidders, stated on the Bid Form Attachment 004322 as a price per unit of measurement for materials or services added to or deducted from the Contract Sum by appropriate modification, if estimated quantities of Work required by the Contract Documents are increased or decreased.

1.4 PROCEDURES

A. Unit Prices include all necessary material plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.

B. Single Unit Price Cost: A single unit price cost shall be provided for both increasing and decreasing estimated base bid quantities; separate unit price cost for increased quantity versus decreased quantity will not be accepted

C. Measurement and Payment: Refer to individual Specification Sections for work that requires establishment of Unit Prices. Methods of measurement and payment for Unit Prices are specified in those Sections.

D. Owner reserves the right to reject Contractor's measurement of Work in-place that involves use of established Unit Prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.

E. List of Unit Prices: A list of Unit Prices is included in Part 3. Specification Sections referenced in the schedule contain requirements for materials described under each Unit Price.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 **LIST OF UNIT PRICES**

A. Unit Price No. 1:

1. Description: Reinforced concrete encased underground duct bank with (2) 4" ducts per the detail on Drawing E-501 including, but not limited to:

   a. Excavation and backfill
   b. 4" Schedule 40 Type DB-60 PVC conduits and duct bank spacers
   c. Reinforcing steel
   d. Red dyed 4,000psi concrete
   e. Underground electric warning tape

2. Unit of Measurement: Linear foot (LF)
3. Base Bid Quantity: 10 LF

END OF SECTION 012200

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: Provide a bus mounted, surge protective device (SPD) in accordance with Specification Section 262416 – Panelboards, factory installed in the following new panelboards:

1. Panelboard MAINT-MDP
2. Panelboard PT-MDP

B. Alternate No. 2: Provide a single series connected string of FIAMM/ALCAD SGL flat plate vented, flooded lead acid batteries and a single battery disconnect switch in lieu of two parallel series connected strings of sealed lead acid batteries, each with a battery disconnect switch per Specification 260115 – Preventative Maintenance for 15kV Metal-Clad Switchgear.

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 012200 "Unit Prices" for procedural requirements for handling and processing Unit Prices.
5. 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 Contactor 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.

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 location1 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[2] 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)

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

[2] The minimum system herein will <u>not be sufficient</u> 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

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

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
013300	Submittals - Record Drawings	As-Builts
013300	Submittals - Notifications & Permits	Certification
013300	Submittals - Quality Control	Certification
013300	Submittals - Inspection & Test Reports	Certification
013300	Submittals - Construction Photographs	Certification
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
016000	Product Requirements - Comparable Product Requests	Product Data
017823	Operation and Maintenance Manual Data	Operation / Maintenance Manual
017900	Demonstration and Training	Certification
024119	Selective Demolition	Construction Schedule
024119	Selective Demolition - Predemolition Photos	Certification
024119	Selective Demolition - Landfill Records	Certification
032000	Concrete Reinforcement	Shop Drawings
033000	Cast-in-Place Concrete	Shop Drawings
033000	Cast-in-Place Concrete	Test Report
260115	Preventative Maintenance for 15kV Metal-Clad Switchgear	Certification
260115	Preventative Maintenance for 15kV Metal-Clad Switchgear	Test Report
260115	Preventative Maintenance for 15kV Metal-Clad Switchgear - Switchgear Battery and Disconnect Switch Product Data	Product Data
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
260519	Low-Voltage Electrical Power Conductors and Cables - 600-volt Building Wire	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 - 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

SPEC SECTION	TITLE	CATEGORY
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 - Anti-Corrosion Thread Sealant	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
260533.16	Boxes for Electrical Systems - Outlet and Non-Dimensioned Junction and Pull Boxes	Product Data
260533.16	Boxes for Electrical Systems - Dimensioned Junction and Pull Boxes	Product Data
260533.16	Boxes for Electrical Systems - Wireways and Wire Troughs	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 - Conduit Marker	Product Data
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 - 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

SPEC SECTION	TITLE	CATEGORY
260573	Protective Device Coordination Study & Arc Flash Risk Assessment - Equipment Label Qualifications	Certification
260573	Protective Device Coordination Study & Arc Flash Risk Assessment - Preliminary 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 & Splices, Including NEC 230.46 compliant splice connectors	Product Data
260583	Wiring Connections - 600-Volt In-Line Splice Insulating Materials	Product Data
261216	Dry-Type, Medium-Voltage Transformers	Product Data
261216	Dry-Type, Medium-Voltage Transformers	Shop Drawings
261216	Dry-Type, Medium-Voltage Transformers	Certification
261216	Dry-Type, Medium-Voltage Transformers	Test Report
261216	Dry-Type, Medium-Voltage Transformers	Operation / Maintenance Manual
261219	Pad-Mounted, Liquid-Filled, Medium-Voltage Transformers	Product Data
261219	Pad-Mounted, Liquid-Filled, Medium-Voltage Transformers - 200A Load-Break Bushing Insert Modules	Product Data
261219	Pad-Mounted, Liquid-Filled, Medium-Voltage Transformers - Surge Arresters	Product Data
261219	Pad-Mounted, Liquid-Filled, Medium-Voltage Transformers - Insulated Protective Caps	Product Data
261219	Pad-Mounted, Liquid-Filled, Medium-Voltage Transformers - Insulated Stand-off Parking Bushings	Product Data
261219	Pad-Mounted, Liquid-Filled, Medium-Voltage Transformers	Shop Drawings
261219	Pad-Mounted, Liquid-Filled, Medium-Voltage Transformers	Certification
261219	Pad-Mounted, Liquid-Filled, Medium-Voltage Transformers	Test Report
261219	Pad-Mounted, Liquid-Filled, Medium-Voltage Transformers	Operation / Maintenance Manual
262416	Panelboards	Product Data
262416	Panelboards - Circuit Breakers	Product Data
262416	Panelboards	Shop Drawings
262416	Panelboards - Seismic Certificate	Certification
262416	Panelboards - SPD (Alternate Bid No. 1)	Product Data
262416	Panelboards - SPD (Alternate Bid No. 1)	Certification
262416	Panelboards - SPD (Alternate Bid No. 1)	Test Report
262416	Panelboards - SPD (Alternate Bid No. 1)	Warranty
262416	Panelboards	Operation / Maintenance Manual
262813	Fuses - Each Type of Fuse	Product Data
262816.13	Enclosed Circuit Breakers	Product Data
262816.13	Enclosed Circuit Breakers	Shop Drawings
262816.16	Enclosed Switches	Product Data
262816.16	Enclosed Switches	Shop Drawings

SPEC SECTION	TITLE	CATEGORY
262913.13	Across-the-Line Motor Controllers	Product Data
262913.13	Across-the-Line Motor Controllers	Shop Drawings
283111	Adressable Fire Alarm System	Product Data
283111	Adressable Fire Alarm System	Shop Drawings
283111	Adressable Fire Alarm System	Certification
283111	Adressable Fire Alarm System	Test Report
283111	Adressable Fire Alarm System	Warranty
283111	Adressable Fire Alarm System	As-Builts
283111	Adressable Fire Alarm System	Operation / Maintenance Manual
311000	Site Clearing	As-Builts
312000	Earth Moving	Product Data
312000	Earth Moving	Certification
312000	Earth Moving	Test Report
321216	Asphalt Paving	Product Data
321216	Asphalt Paving	Certification
321216	Asphalt Paving	Test Report
329200	Turfs and Grasses	Product Data
329200	Turfs and Grasses	Certification
337110	Medium-Voltage Outdoor Sectionalizing Cabinets	Product Data
337110	Medium-Voltage Outdoor Sectionalizing Cabinets - Junctions	Product Data
337110	Medium-Voltage Outdoor Sectionalizing Cabinets - Stand-off Parking Bushings	Product Data
337110	Medium-Voltage Outdoor Sectionalizing Cabinets - Surge Arresters	Product Data
337110	Medium-Voltage Outdoor Sectionalizing Cabinets	Shop Drawings
337110	Medium-Voltage Outdoor Sectionalizing Cabinets	Certification
337119.13	Electrical Underground Ducts - Each Type of Conduit	Product Data
337119.13	Electrical Underground Ducts - Fiberglass Long Radius Elbows	Product Data
337119.13	Electrical Underground Ducts - Intumescent Silicone Sealant	Product Data
337119.13	Electrical Underground Ducts - Protective Coating for Direct Buried Metal Conduit	Product Data
337119.13	Electrical Underground Ducts - Underground Conduit Warning Tape	Product Data
337119.13	Electrical Underground Ducts - Conduit Pull Tape	Product Data
337119.13	Electrical Underground Ducts - Conduit/Duct Plugs	Product Data
337119.13	Electrical Underground Ducts - Conduit Spacers for Conduit Duct Banks	Product Data
337119.13	Electrical Underground Ducts - Red Cement Coloring Dye for Concrete Encased 12.47kV Conduit Duct Banks	Product Data
337149	Medium-Voltage Wiring - Medium Voltage Power Cable	Product Data
337149	Medium-Voltage Wiring - Medium Voltage Cable Termination Kits	Product Data

SPEC SECTION	TITLE	CATEGORY
337149	Medium-Voltage Wiring - Medium Voltage Cable Splice Kits	Product Data
337149	Medium-Voltage Wiring - Medium Voltage Cable Arc-Proofing Tapes	Product Data
337149	Medium-Voltage Wiring - Medium Voltage Cable Moisture Seals	Product Data
337149	Medium-Voltage Wiring - Medium Voltage Cable Splice and Termination Installer Qualifications	Certification
337149	Medium-Voltage Wiring - Medium Voltage Cable DC HiPot Testing Technician Qualifications	Certification
337149	Medium-Voltage Wiring - Medium Voltage Cable	Test Report
337710	Medium-Voltage Pad-Mounted Switchgear	Product Data
337710	Medium-Voltage Pad-Mounted Switchgear	Shop Drawings
337710	Medium-Voltage Pad-Mounted Switchgear	Certification
337710	Medium-Voltage Pad-Mounted Switchgear	Test Report
337710	Medium-Voltage Pad-Mounted Switchgear	Operation / Maintenance Manual

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 1 Specification Sections apply to this Section.

1.2 SUMMARY

A. This Section includes general Institution rules.

B. This Section includes requirements for infection control in environments that Clients are housed in, dine in, or participate in program activities in or adjacent to the Scope of Work area:

1. The Contractor shall have the applicable measures specified below in-place any time demolition or construction activities occur in occupied or non-occupied project work areas.
2. 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 Clients do not occupy during construction.

1.3 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.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 GENERAL RULES OF THE INSTITUTION

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 or Patients are to be treated with dignity.
2. Construction activities shall not interfere with normal facility operation, except as otherwise arranged with and approved by the Facility Authorities.
3. Access to the Facility, Residents, and Staff by Emergency Responders shall not be compromised at any time.
4. Fire exits, alarm systems, and sprinkler systems shall remain fully operational at all times unless written approval is received from the Construction Representative and the appropriate Facility Representative at least (24) hours in advance. The Contractor shall

submit a written time schedule for any proposed shutdowns.

5. Smoking is not permitted in State-operated buildings. Smoking on grounds shall be in accordance with local Facility regulations and only as approved by Facility Management.
6. Intoxicating beverages or narcotics shall not be brought upon the premises nor shall Contractor's personnel be under the influence of these substances while on the premises.
7. Explosives or firearms and other weapons shall not be allowed onsite.
8. Keys shall not be left in unattended vehicles. Vehicles shall be locked when not in use.
9. The Residents shall not be photographed. Maintaining confidentiality of the Residents shall be required.

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

1. Materials, tools, and construction apparatus including 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 location and use of exterior storage areas shall be approved by the Construction Representative and Facility Management prior to their use.
2. An inventory of tools, equipment, and materials intended to be left unsecured must be submitted to and approved by the Construction Representative in advance.
3. Any missing tools, equipment, or material must be immediately reported to the Construction Representative and Facility Management. Unattended or unsecured tools, equipment, or material that poses a potential risk may be confiscated by Facility Staff and returned 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. Material Safety Data Sheets, or their equivalent, shall be provided to the Construction Representative for all hazardous materials to be brought onsite at least a day before their delivery.
6. 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 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.

3.2 ACCESS TO THE SITE

A. The Contractor shall coordinate with the Facility and Construction Representative to establish a schedule for working hours. Normal working hours for this Facility are 7:30AM to 4:00PM Monday through Friday. Working hour changes or overtime are to be requested and approved (48) hours in advance. The need for emergency overtime shall be reported to the Construction Representative as soon as it is evident that overtime is needed.

B. The Contractor shall provide the name and phone number of the individual who is in charge onsite and who can be contacted in case of an emergency. This individual must maintain a current list of names and addresses of all project construction personnel and to furnish this list to the Construction Representative or Facility Representative upon request.

C. All construction personnel shall be identified to the Facility Representative and, when the

Facility Representative feels it is necessary, they will be issued identification cards.

3.3 HEALTH AND TRAFFIC CONTROLS

A. Take all reasonable and necessary measures to reduce air and water pollution by any material or equipment used during construction. Keep volatile wastes in approved covered containers. Do not dispose of volatile wastes or oils in storm or sanitary drains.

B. Keep project area in a neat, clean, orderly, and safe condition at all times. Immediately remove all waste materials. Do not allow trash or rubbish to accumulate. Provide approved onsite containers for collection of trash and rubbish and dispose of it at frequent intervals during progression of the Work.

C. No burning will be permitted on the grounds.

D. Conduct all construction-related activities and management of debris to ensure minimum interference with roadways, streets, walks, utilities, and adjacent facilities.

E. Do not obstruct streets, driveways, walks, or use facilities without permission from the Facility Representative.

F. No driver shall exceed the Facility speed limit of 5mph.

3.4 SPECIFICATION OF REQUIRED INFECTION CONTROL PRECAUTIONS BY CLASS

A. The Facility Contact or the DMH Capital Improvements Administrator will help you determine which Class applies to this particular project.

B. Class I is for inspection and non-invasive type activities. These include, but are not limited to, the removal of ceiling tiles for visual inspection (1) tile per 50SqFt, painting without sanding, wall covering, electrical trim work, minor plumbing, and activities which do not generate dust or require cutting of walls or access to ceilings other than for visual inspection.

1. Class I Contractor shall perform the following precautionary measures during the project:

    a. Execute work by methods to minimize raising dust from construction operations.
    b. Immediately replace a ceiling tile displaced for visual inspection.

2. Class I Contractor shall perform the following measures upon completion of the project.

    a. No work is required.

C. Class II is for work that generates minimal to a high level of dust, requires demolition, or removal of any fixed building components or assemblies. Work of this type includes, but is not limited to, installation of telephone and computer cabling, access to chase spaces, cutting of walls or ceiling where dust migration can be controlled, sanding of walls for painting or wall covering, removal of floor coverings, ceiling tiles and casework, new wall construction, minor duct work, electrical or plumbing work above ceilings, and any activity that cannot be completed within a single work shift.

1. Class II Contractor shall perform the following precautionary measures during the project:

a. Provide active means to prevent airborne dust from dispersing into the atmosphere.
b. Water mist work surfaces to control dust while cutting.
c. Seal unused doors with duct tape.
d. Block off and seal air vents.
e. Place dust mat at entrance and exit of work area.
f. Remove or isolate HVAC system in areas where work is being performed.

2. Class II Contractor shall perform the following measures upon completion of the project:

a. Wipe work surfaces with disinfectant.
b. Contain construction waste before transport in tightly covered containers.
c. Wet mop and/or vacuum with HEPA filtered vacuum before leaving work area.
d. Remove isolation of HVAC system in areas where work was performed.

D. Class III is for major demolition and construction projects. Work includes, but is not limited to, activities which require consecutive work shifts, heavy demolition, the removal of a complete cabling system, and new construction.

1. Class III Contractor shall perform the following precautionary measures during the project:

a. Remove or isolate HVAC system in area where work is being done to prevent contamination of duct system including block off and seal air vents.
b. Complete all critical barriers, i.e., drywall, plywood, and plastic to seal area from non-work area or implement control cube method (use cart with plastic covering and sealed connection to worksite with HEPA vacuum for vacuuming prior to exit) before construction begins.
c. Maintain negative air pressure within worksite utilizing HEPA equipped air filtration units.
d. Place dust mat at entrance and exit of work area.
e. Contain construction waste before transport in tightly covered containers.
f. Cover transport receptacles or carts. Tape covering unless solid lid.

2. Class III Contractor shall perform the following measures upon completion of the project:

a. Do not remove barriers from work area until completed project is inspected by the Construction Representative and a Representative of the Facility's Safety and Inspection Control Section.
b. Remove barrier materials carefully to minimize spreading of dirt and debris associated with construction.
c. Vacuum work area with HEPA filtered vacuums.
d. Wet mop area with disinfectant.
e. Remove isolation of HVAC system in areas where work is being performed.

3.5 SECURITY CLEARANCES AND RESTRICTIONS

A. FMDC CONTRACTOR BACKGROUND AND ID BADGE PROCESS

1. All employees of an OA/FDMC contractor (or subcontractor performing work under an OA/FMDC contract) are required to submit a fingerprint check through the Missouri State Highway Patrol (MSHP) and the FBI enabling OA/FMDC to obtain state and national criminal background checks on the employees, unless stated otherwise in the

Contractor's contract.

2. 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.
3. 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 a list of the names of the Contractor's employees who will be fingerprinted and a signed OA/FMDC Authorization for Release of Information Confidentiality Oath 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/facilities/facilities-operations/security-information/fmdc-contractor-background-and-id-badge
4. Fingerprints and Authorization for Release of Information Confidentiality Oath form are valid for one (1) year and must be renewed annually. Changing or adding locations may result in additional required documentation. Certain employees may be required to be fingerprinted more frequently. OA/FMDC reserves the right to request additional background checks at any time for any reason.

B. The Contractor shall notify FMDC via email to FMDCSecurity@oa.mo.gov within 48 hours of anyone severing employment with their company.

3.6 PROTECTION OF PERSONS AND PROPERTY

A. SAFETY PRECAUTIONS AND PROGRAMS

1. The Contractor shall at all times conduct operations under this Contract in a manner to avoid the risk of bodily harm to persons or risk of damage to any property. The Contractor shall promptly take precautions which are necessary and adequate against conditions created during the progress of the Contractor's activities hereunder which involve a risk of bodily harm to persons or a risk of damage to property. The Contractor shall continuously inspect Work, materials, and equipment to discover and determine any such conditions and shall be solely responsible for discovery, determination, and correction of any such conditions. The Contractor shall comply with applicable safety laws, standards, codes, and regulations in the jurisdiction where the Work is being performed, specifically, but without limiting the generality of the foregoing, with rules regulations, and standards adopted pursuant to the Williams-Steiger Occupational Safety and Health Act of 1970 and applicable amendments.
2. All contractors, subcontractors and workers on this project are subject to the Construction Safety Training provisions 292.675 RSMo.
3. In the event the Contractor encounters on the site, material reasonably believed to be asbestos, polychlorinated biphenyl (PCB), lead, mercury, or other material known to be hazardous, which has not been rendered harmless, the Contractor shall immediately stop Work in the area affected and report the condition to the Owner's Representative and the Architect in writing. The Work in the affected area shall not thereafter be resumed except by written agreement of the Owner's Representative and Contractor if in fact the material is asbestos or polychlorinated biphenyl (PCB) and has not been rendered harmless. The Work in the affected area shall be resumed in the absence of asbestos or polychlorinated biphenyl (PCB), or when it has been rendered harmless by written agreement of the Owner's Representative and the Contractor. "Rendered Harmless" shall mean that levels

of such materials are less than any applicable exposure standards, including but limited to OSHA regulations.

B. SAFETY OF PERSONS AND PROPERTY

1. The Contractor shall take reasonable precautions for safety of, and shall provide protection to prevent damage, injury, or loss to:

   a. clients, staff, the public, construction personnel, and other persons who may be affected thereby;
   b. the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody, or control of the Contractor or the Contractor's Subcontractors of any tier; and
   c. other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction.

2. The Contractor shall give notices and comply with applicable laws, standards, codes, ordinances, rules, regulations, and lawful orders of public authorities bearing on safety of persons or property or their protection from damage, injury, or loss.
3. The Contractor shall erect and maintain, as required by existing conditions and performance of the Contract, safeguards for safety and protection, including, but not limited to, posting danger signs and other warnings against hazards, promulgating safety regulations, and notifying owners and users of adjacent sites and utilities.
4. When use or storage of explosives or other hazardous materials or equipment or unusual methods are necessary for execution of the Work, the Contractor shall exercise the highest degree of care and carry on such activities under supervision of properly qualified personnel.
5. The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in this Section caused in whole or in part by the Contractor, a Subcontractor of any tier, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable, and for which the Contractor is responsible under this Section, except damage or loss attributable solely to acts or omissions of Owner or the Architect or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's other obligations stated elsewhere in the Contract.
6. The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents, and the maintaining, enforcing and supervising of safety precautions and programs. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner's Representative and Architect. The Contractor shall hold regularly scheduled safety meetings to instruct Contractor personnel on safety practices, accident avoidance and prevention, and the Project Safety Program. The Contractor shall furnish safety equipment and enforce the use of such equipment by its employees and its subcontractors of any tier.
7. The Contractor shall not load or permit any part of the construction or site to be loaded so as to endanger its safety.
8. The Contractor shall promptly report in writing to the Owner all accidents arising out of or in connection with the Work which cause death, lost time injury, personal injury, or property damage, giving full details and statements of any witnesses. In addition, if death, serious personal injuries, or serious property damages are caused, the accident

shall be reported immediately.

9. The Contractor shall promptly notify in writing to the Owner of any claims for injury or damage to personal property related to the work, either by or against the Contractor.
10. The Owner assumes no responsibility or liability for the physical condition or safety of the Work site or any improvements located on the Work site. The Contractor shall be solely responsible for providing a safe place for the performance of the Work. The Owner shall not be required to make any adjustment in either the Contract Sum or Contract Time concerning any failure by the Contractor or any Subcontractor to comply with the requirements of this Paragraph.
11. In no event shall the Owner have control over, charge of, or any responsibility for construction means, methods, techniques, sequences or procedures or for safety precautions and programs in connection with the Work, notwithstanding any of the rights and authority granted the Owner in the Contract Documents.
12. The Contractor shall maintain at his own cost and expense, adequate, safe and sufficient walkways, platforms, scaffolds, ladders, hoists and all necessary, proper, and adequate equipment, apparatus, and appliances useful in carrying on the Work and which are necessary to make the place of Work safe and free from avoidable danger for clients, staff, the public and construction personnel, and as may be required by safety provisions of applicable laws, ordinances, rules regulations and building and construction codes.

END OF SECTION 013513.19

SECTION 015000 – CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes requirements for construction facilities and temporary controls including temporary utilities, support facilities, security, and protection.

B. Temporary utilities include, but are not limited to, the following:

1. Water service and distribution
2. Temporary electric power and light
3. Temporary heat
4. Ventilation
5. Sanitary facilities, including drinking water
6. Storm and sanitary sewer

C. Support facilities include, but are not limited to, the following:

1. Field offices and storage sheds
2. Dewatering facilities and drains
3. Temporary enclosures
4. Temporary project identification signs and bulletin boards
5. Waste disposal services
6. Construction aids and miscellaneous services and facilities

D. Security and protection facilities include, but are not limited to, to 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 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.

1.4 PROJECT CONDITIONS

A. Temporary Utilities: Prepare a schedule indicating dates for implementation and termination of each temporary utility. At the earliest feasible time, when acceptable to the Owner, change over from use of temporary service to use of permanent service.

B. Conditions of Use: Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Relocate temporary services and facilities as the Work progresses. Do not overload facilities or permit them to interfere with progress. Take necessary fire-prevention measures. Do not allow hazardous, dangerous, or unsanitary conditions, or public nuisances to develop or persist onsite.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide new materials. If acceptable to the Designer, the Contractor may use undamaged, previously used materials in serviceable condition. Provide materials suitable for use intended.

B. Lumber and Plywood: Comply with requirements in Division 6 Section "Rough Carpentry".

1. For job-built temporary sheds within the construction area, provide UL-labeled, fire-treated lumber and plywood for framing, sheathing, and siding.

2. For signs and directory boards, provide exterior-type, Grade B-B high-density concrete form overlay plywood of sized and thicknesses indicated.

3. For fences and vision barriers, provide minimum 3/9" (9.5mm) thick exterior plywood.

4. For safety barriers, sidewalk bridges, and similar uses, provide minimum 5/8" (16mm) thick exterior plywood.

C. Roofing Materials: Provide UL Class A standard-weight asphalt shingles or UL Class C mineral-surfaced roll roofing on roofs of job-built temporary sheds.

D. Paint:

1. For job-built temporary sheds, fences, and other exposed lumber and plywood, provide exterior-grade acrylic-latex emulsion over exterior primer.

2. For sign panels and applying graphics, provide exterior-grade alkyd gloss enamel over exterior primer.

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. Water: Provide potable water approved by local health authorities.

G. Open-Mesh Fencing: Provide 0.120" (3mm) thick, galvanized 2" (50mm) chainlink fabric fencing 6' (2m) high with galvanized steel pipe posts, 1½" (38mm) ID for line posts and 2½" (64mm) ID for corner posts.

2.2 EQUIPMENT

A. General: Provide new equipment. If acceptable to the Designer, the Contractor may use undamaged, previously used equipment in serviceable condition. Provide equipment suitable for use intended.

B. Water Hoses: Provide ¾" (19mm), heavy-duty, abrasion-resistant, flexible rubber hoses 100' (30m) long, with pressure rating greater than the maximum pressure of the water distribution system. Provide adjustable shutoff nozzles at hose discharge.

C. Electrical Outlets: Provide properly configured, NEMA-polarized outlets to prevent insertion of 110 to 120V plugs into higher voltage outlets. Provide receptacle outlets equipped with ground-fault circuit interrupters, reset button, and pilot light for connection of power tools and equipment.

D. Electrical Power Cords: Provide grounded extension cords. Use hard-service cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate lengths of electric cords if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length-voltage rating.

E. Lamps and Light Fixtures: Provide general service incandescent lamps of wattage required for adequate illumination. Provide guard cages or tempered-glass enclosures where exposed to breakage. Provide exterior fixture where exposed to moisture.

F. Heating Units: Provide temporary heating units that have been tested and labeled by UL, FM, or another recognized trade association related to the type of fuel being consumed.

G. Temporary Offices: The Owner will provide an Owner designated, unsecure, limited area in Maintenance Building for Contractor's use only during Facilities normal working hours so long that as facilities are cleaned and maintained in a condition acceptable to the Owner. All construction personnel will be allowed access only to those specific facilities designated by the Construction Representative. Contractor has the option of providing their own prefabricated or mobile units or similar job-built construction with lockable entrances, operable windows, and serviceable finishes. Location shall be to the discretion of the Construction Representative. Provide heated and air-conditioned units on foundations adequate for normal loading. Contractor is responsible for providing their own prefabricated or mobile unit's utilities.

H. Temporary Toilet Units: Use of Owner's existing toilet facilities will be permitted, so long as facilities are cleaned and maintained in a condition acceptable to the Owner. All construction personnel will be allowed access only to those specific facilities designed by the Construction Representative. At substantial completion, restore these facilities to the condition prevalent at the time of initial use.

I. Fire Extinguishers: Provide hand-carried, portable, UL-rated, Class A fire extinguishers for temporary offices and similar spaces. In other locations, provide hand-carried, portable, UL-rated, Class ABC, dry-chemical extinguishers, or a combination of extinguishers of NFPA-recommended classes for the exposures.

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

PART 3 - EXECUTION

3.1 INSTALLATION

A. Use qualified personnel for installation of temporary facilities. Locate facilities where they will serve the Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required.

B. Provide each Facility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

A. 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.

B. Temporary Electric Power Service for Temporary Lighting and Power Tools: The Owner will provide electric power for construction lighting and power tools. Contractors using such services shall pay all costs of temporary services, circuits, outlets, extensions, etc.

C. Temporary Electric Power Service for Welders and Other High Energy Use Equipment: The Contractor shall provide temporary electrical power generators and temporary electrical extensions for Contractor's use of welders and other high energy use equipment.

D. Temporary Lighting: Provide temporary lighting with local switching.

1. Install and operate temporary lighting that will fulfill security and protection requirements without operating the entire system. Provide temporary lighting that will provide adequate illumination for construction operations and traffic conditions.

E. Temporary Heating: Provide temporary heat required by construction activities for curing or drying of completed installations or for protection of installed construction from adverse effects of low temperatures or high humidity. Select safe equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate

ventilation requirements to produce the ambient condition required and minimize consumption of energy.

1. Heating Facilities: Except where the Owner authorizes use of the permanent system, provide vented, self-contained, LP gas or fuel-oil heaters with individual space thermostatic control.

2. Use of gasoline-burning space heaters, open flame, or salamander heating units is prohibited.

F. 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.

G. Temporary Toilets: Use of the Owner's existing toilet facilities will be permitted, so long as facilities are cleaned and maintained in a condition acceptable to the Owner. All construction personnel will be allowed access only to those specific facilities designed by the Construction Representative. At substantial completion, restore these facilities to the condition prevalent at the time of initial use.

H. 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.

I. Drinking-Water Facilities: The Owner will provide drinking water facilities within the building. All construction personnel will be allowed access only to those specific facilities designated by the Construction Representative.

J. 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 temporary offices, storage sheds and other temporary construction and support facilities for easy access.

1. Maintain support facilities until near Substantial Completion. Remove prior to Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to the Owner.

B. Field Offices (Contractor Option): If selected for use by Contractor, provide insulated, weathertight temporary offices of sufficient size to accommodate Contractor's use at the Project site. Keep the office clean and orderly.

C. Storage Facilities: Install storage sheds or containers sized, furnished, and equipped to accommodate materials and equipment involved, including temporary utility service. No area of storage will be made available inside any of Owner's buildings. The Contractor shall provide their own security. Specific locations for outside storage onsite will be discussed at the Pre-Bid Meeting and the Pre-Construction Meeting and as designated by the Construction Representative.

D. Construction Parking: Parking at the site will be provided in the areas designated at the Pre-Construction Meeting.

E. 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 31 Sections. Where feasible, utilize the same facilities. Maintain the site, excavations, and construction free of water.

F. 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. Close openings through floor or roof decks and horizontal surfaces with load-bearing, wood-framed construction.

4. Where temporary wood or plywood enclosure exceeds 100SqFt (9.2SqM) in area, use UL-labeled, fire-retardant-treated material for framing and main sheathing.

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. Temporary Exterior Lighting: Install exterior yard and sign lights so signs are visible when Work is being performed.

I. 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. Except for use of permanent fire protection as soon as available, do not change over from use of temporary security and protection facilities to permanent facilities until Substantial Completion, or longer, as requested by the Designer.

B. Temporary Fire Protection: Until fire-protection needs are supplied by permanent facilities, install and maintain temporary fire-protection facilities of the types needed to protect against reasonable predictable and controllable fire losses. Comply with NFPA 10 “Standard for Portable Fire Extinguishers” and NFPA 241 “Standard for Safeguarding Construction, Alterations, and Demolition Operations”.

1. Locate fire extinguishers where convenient and effective for their intended purpose, but not less than one (1) extinguisher on each floor at or near each usable stairwell.

2. Store combustible materials in containers in fire-safe locations.

3. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire-protection facilities, stairways, and other access routes for fighting fires. Prohibit smoking in hazardous fire-exposure areas.

4. Provide supervision of welding operations, combustion-type temporary heating units, and similar sources of fire ignition.

C. Permanent Fire Protection: At the earliest feasible date in each area of the Project complete installation of the permanent fire-protection facility including connected services and place into operation and use. Instruct key personnel on use of facilities.

D. 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.

E. 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.

F. 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.

G. 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. 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 26, Section 260500 “Common Work Results for Electrical”, Article 1.8 "Reference Standards" for applicable industry standards for products specified.
4. Refer to Division 28, Section 283111 “Addressable Fire Alarm System”, Article 1.4 “References” 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 impending 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 33 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 electronic file for review on eBuilder.
2. *For Final Submission*:

a. PDF Electronic File on USB thumb drive.

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 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 Designer.
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 Designer.

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. Designer 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 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 specializes 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 facility.

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:

1. Power fuses removed from existing medium-voltage pad-mounted switchgear.

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 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 formwork for cast-in-place concrete.

1.3 RELATED SECTIONS

A. Section 032000 – Concrete Reinforcement

B. Section 033000 – Cast-In-Place Concrete

1.4 REFERENCES

A. ACI 117 - Tolerances for Concrete Construction and Materials.

B. ACI 301 - Structural Concrete for Buildings.

C. ACI 318 - Building Code Requirements for Reinforced Concrete.

D. ACI 347 - Recommended Practice for Concrete Formwork.

E. AF&PA - National Design Specifications for Wood Construction.

F. ASTM D 1752 - Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction.

G. SPIB - 1994 Standard Grading Rules for Southern Pine Lumber (and Supplements).

H. WCLIB Rule No. 17 - Standard Grading and Dressing Rules.

1.5 DESIGN REQUIREMENTS

A. The design, engineering, and construction of all form work shall be the responsibility of Contractor.

B. Design, engineer and construct formwork, shoring and bracing to conform to design and code requirements with resultant concrete conforming to required shape, line and dimension.

C. All formwork shall be designed for the loads, lateral pressures, and allowable stresses outlined in ACI 347, “Recommended Practice for Concrete Formwork” and for design considerations, wind loads, allowable stresses and other applicable requirements of the controlling local building code.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 347, ACI 301 and ACI 318.

B. For wood products furnished for Work of this Section, comply with applicable provisions of AF&PA National Design Specifications for Wood Construction.

C. Maintain one copy of each document on site.

1.7 COORDINATION

A. Coordinate this Section with other sections of work, which require attachment of components to formwork.

B. Place formwork to obtain sufficient concrete cover over reinforcement.

C. Coordinate this Section with other sections of the work, which require application of finishes or waterproofing to formed concrete surfaces.

1. Verify that formwork and accessories are compatible with concrete finishes, coatings, waterproofing systems, etc.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

A. Exposed Concrete: Unless otherwise shown or specified, construct formwork for exposed concrete surfaces with plywood, metal, metal-framed plywood faces or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces.

B. Unexposed Concrete: Form concrete surfaces which will be unexposed in finished structure with plywood, lumber, metal or other acceptable material.

C. Steel forms, if used, shall be flat and smooth, without dents, free of rust and shall be tight fitting for all exposed surfaces.

D. Provide form material with sufficient thickness to withstand pressure of newly-placed concrete without bow or deflection.

2.2 WOOD FORM MATERIALS

A. Lumber Forms: Use for edge forms and unexposed finish concrete. Boards shall be 6 inches or 8 inches in width, shiplapped or tongue and groove, “Standard” Grade Douglas Fir, conforming to WCLIB Standard Grading and Dressing Rule No. 17. Surface boards on four sides.

B. Plywood Forms: Use for exposed finish concrete. Forms shall conform to PS-1. Each panel shall carry the grade trademark of the APA/EWA and shall be full size 4-foot by 8-foot panels.

1. Plywood for surfaces to receive membrane waterproofing shall be a minimum of 5/8-inch thick and shall be APA “B-B Plyform Structural I Exterior” grade.
2. Plywood where “Smooth Finish” is required, as shown on Drawings, shall be “HD Overlay Plyform Structural I Exterior” grade, minimum of 3/4-inch thick.

2.3 PREFABRICATED FORMS

A. Manufacturers:

1. Aluma-Systems Inc., Burke Co.
2. Economy Forms Corp.
3. Molded Fiber Glass Concrete Forms Co.
4. Perma Tubes.
5. Sonoco Products Co.
6. Symons Corp.
7. Western Forms, Inc.

B. Preformed Steel Forms: Minimum 16 gage matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.

C. Glass Fiber Fabric Reinforced Plastic Forms: Matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished concrete surfaces.

D. Pan Type: Steel of size and profile required.

E. Steel Forms: Sheet steel, suitably reinforced, and designed for the particular use shown on Drawings.

F. Form Liners: Smooth, durable, grainless and non-staining hardboard, unless otherwise shown on Drawings.

G. Framing, Studding and Bracing: Stud or No. 3 structural light framing grade.

2.4 METAL FORM DECK

A. Metal deck shall be fabricated from high strength steel sheets conforming to ASTM A653 having a minimum yield strength of 80,000 psi.

B. Deck shall be minimum 20-gauge, box rib with paint grip ASTM A653/A924 galvanized finish.

C. Deck shall be placed with the ribs perpendicular to the supports and shall be continuous to the extent possible. End laps when required shall be a minimum of 2". All sheets shall bear on concrete walls for 3" in accordance with the manufacturer's erection standards.

D. Welding washers shall be furnished as required. Sheetmetal end closers shall be furnished and installed to prevent concrete leaking from the forms.

E. Deck shall be provided as required during concrete placing to limit maximum fiber stress to 30,000 psi and deflection to 1/240 of the span under the slab dead load plus a 20 psf construction load.

2.5 FORMWORK ACCESSORIES

A. Form accessories to be partially or wholly embedded in the concrete shall be of a suitable commercially manufactured type.

B. Form Ties: Removable type, metal, adjustable length, cone type with waterproofing washer.

1. Ties shall have no metal within 1” of finished surface.
2. Ties shall leave holes not less than 1/2” nor more than 1” in depth.
3. Ties shall leave holes no larger than 1” diameter in concrete surface.

C. Spreaders: Standard, noncorrosive metal form clamp assembly, of type acting as spreaders and leaving no metal within 1 inch of concrete face. No wire ties, wood spreaders or through bolts will be permitted.

D. In walls reinforced with epoxy coated bars, spreader bars shall be epoxy coated.

E. Proprietary combination bar clips and spreaders used in walls with epoxy coated reinforcing bars shall be made of corrosion-resistant material or coated with dielectric material.

F. Form Anchors and Hangers: Anchors and hangers used for exposed concrete shall not leave exposed metal at surface. Hangers supporting forms from structural steel shall be symmetrically arranged on supporting members to minimize twisting or rotation of member. Penetration of structural steel members will not be permitted.

G. Form Release Agent: Colorless non-staining agent which will not absorb moisture or impair natural bonding or color characteristics of waterproofing or coating intended for use on concrete.

H. Corners: Chamfer; 1 inch by 1-inch size; maximum possible lengths.

I. Waterproofing Membranes: Where shown on drawings, as specified in Division 7.

J. Joint Filler: ASTM D 1752.

K. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete.

L. Waterstops: Where shown on drawings, as specified in Section 031505.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify lines, levels, and centers before proceeding with formwork. Ensure that dimensions agree with Drawings.

3.2 INSTALLATION

A. All footings and foundations shall be formed.

B. Pouring concrete against soil on the sides of the excavation will not be permitted unless shown on the Drawings.

C. Formwork - General: Sloped surfaces steeper than 1.5 horizontal to 1 vertical should be provided with a top form to hold the shape of the concrete during placement, unless it can be demonstrated that top forms can be omitted.

D. Construct forms to the correct shape and dimensions, mortar-tight, of sufficient strength, and so braced and tied together that movement of workers, equipment, materials, or the

placing and vibrating of concrete shall not affect formwork and finished construction. Forms shall be strong enough to maintain their shape under all imposed loads.

E. Provide positive means of adjustment (wedges or jacks) of shores and struts.

F. Camber where necessary to assure level finished soffits unless otherwise shown on Drawings.

G. Verify horizontal and vertical positions of forms and correct inaccuracies before placing concrete in any form.

H. Complete wedging and bracing before placing concrete.

I. Take up all settlement during the concrete placing operations.

J. Forms for Surfaces to Receive Membrane Waterproofing: Use plywood or steel forms. After erection of forms, tape form joints to prevent protrusions in concrete.

K. Framing, Studding and Bracing: Space studs at 16 inches on center maximum for boards and 12 inches on center maximum for plywood.

1. Framing, bracing, centering, and supporting members shall be of adequate size and strength to carry safely, without deflection, all dead and live loads to which forms may be subjected and shall be spaced sufficiently close to prevent any bulging or sagging of forms.
2. Soffits of all beam forms shall be constructed of material a minimum of 2 inches thick.
3. Distribute bracing loads over base area on which bracing is erected.
4. When placed on ground, protect against undermining, settlement or accidental impact.

L. Erect formwork, shoring, and bracing to achieve design requirements, in accordance with requirements of ACI 301.

M. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.

N. Forms shall be constructed so that they can be removed without hammering or prying against concrete.

O. Obtain approval before framing openings in structural members that are not indicated on Drawings.

P. Provide chamfer strips on external corners of beams and pilasters.

Q. Do not reuse wood formwork more than 3 times for concrete surfaces to be exposed to view. Do not patch formwork.

3.3 APPLICATION - FORM RELEASE AGENT

A. Apply form release agent on formwork in accordance with manufacturer's recommendations.

B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.

C. Excess material shall not be allowed to stand in puddles in the forms nor allowed to come in contact with concrete against which fresh concrete will be placed.

D. Do not apply form release agent where concrete surfaces will receive applied coverings such as a waterproof membrane that are affected by agent.

1. Soak inside surfaces of untreated forms with clean water.
2. Keep surfaces coated prior to placement of concrete.

E. Reuse and Coating of Forms: Thoroughly clean forms and reapply form coating before each reuse.

1. For exposed work, do not reuse any form which cannot be reconditioned to "like new" condition.
2. Apply form coating to all forms in accordance with the manufacturer's specifications, except where "scored finish" is required as shown on the Drawings.
3. Do not coat forms for concrete that is to receive a "scored finish".
4. Apply form coatings before placing reinforcing steel.

3.4 INSERTS, EMBEDDED PARTS, AND OPENINGS

A. Provide formed openings where required.

B. Accurately locate, set in place, and securely fasten items that will be cast directly into concrete.

C. Voids in sleeves, inserts, anchor slots, etc., shall be filled temporarily with readily removable material to prevent entry of concrete into the voids.

D. All embedded items shall be clean and free of oil and other foreign matter such as loose coatings of rust, paint, and scale. The embedding of wood in concrete shall be avoided except where specifically shown on the Drawings.

E. Coordinate with Work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other Work.

F. Install accessories straight, level, and plumb. Ensure items are not disturbed during concrete placement.

G. Install waterstops continuous without displacing reinforcement. Heat seal joints watertight.

H. 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.

I. 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.

J. Form Ties: Use sufficient strength and sufficient quantity to prevent spreading of the forms. Place ties at least 1 inch away from the finished surface of the concrete.

1. Leave inner rods in concrete when forms are stripped.
2. Space all form ties to be equidistant, and symmetrical and lined up both vertically and horizontally unless otherwise shown on Drawings.

K. Arrangement: Arrange formwork to allow proper erection sequence and to permit form removal without damage to concrete.

L. Construction Joints: Provide a surfaced pouring strip where construction joints intersect exposed surfaces to provide a straight line at joints. Just prior to subsequent concrete placement, remove strip and tighten forms to conceal shrinkage. Show no overlapping of construction joints, as closely as possible, to present the same appearance as butted plywood joints. Joints in a continuous line shall be straight, true and sharp.

M. Embedded Items: Make provisions for pipes, sleeves, anchors, inserts, reglets, anchor slots, nailers, waterstops, and other features. No wood or uncoated aluminum shall be embedded in concrete. Obtain any required information pertaining to embedded items to be furnished for the work specified in other sections. Securely anchor all embedded items in correct location and alignment prior to placing concrete. Conduits and pipes, including those made of coated aluminum, must meet the requirements of ACI 318.

N. Openings for Items Passing Through Concrete: Frame openings in concrete where shown on the Drawings. Establish exact locations, sizes, and other conditions required for openings and attachment of work specified under other sections. Coordinate all work of this nature in order that there shall be no unnecessary cutting and patching of concrete. Perform any cutting and repairing of concrete required as a result of failure to provide for such openings.

O. Screeds: Set screeds and establish levels for tops of concrete slabs and levels for finish on slabs. Slope slabs to drain where required or as shown on the Drawings. Before depositing concrete, remove all debris from the space to be occupied by the concrete and thoroughly wet all forms. Remove freestanding water.

P. Screed Supports: For concrete over waterproof membranes and vapor barrier membranes, use screeds supports of a cradle, pad or base type which shall not puncture the membrane. Staking through the membrane will not be permitted.

Q. Cleanouts and Access Panels: Provide removable cleanout sections or access panels at the bottoms of all forms to permit inspection and effective cleaning of loose dirt, debris and waste material. Clean all forms and surfaces against which concrete is to be placed of all chips, saw dust and other debris and thoroughly blow out with compressed air just before concrete is placed.

3.5 FIELD QUALITY CONTROL

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

B. Inspect erected formwork to ensure that work will provide a concrete surface suitable for exposure or for application of concrete finishes, coatings, waterproofing, etc.

C. Notify Construction Representative after placement of reinforcing steel in the forms, but prior to placing concrete, so that inspection may be made.

3.6 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.

3.7 FORM REMOVAL

A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads and the removal has been approved by Construction Representative.

B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.

C. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged. Discard damaged forms.

D. Forms shall be left in place for not less than the total number of days as specified in ACI 347.

E. The Contractors registered engineer will determine the time and sequence of formwork and shoring removal for formwork supporting weight of concrete, such as beams, roof slabs, and self-supporting walls.

1. Contractor shall consider temperature, deadload, construction live loads, etc., in timing of formwork removal.
2. In any event, formwork supporting weight of concrete shall not be removed until concrete has reached compressive strength no less than 75% of the specified minimum 28-day compressive strength, and no sooner than seven (7) days.

3.8 ERECTION TOLERANCES

A. Formwork shall be constructed such that the finished concrete surfaces are free of any abrupt dimensional changes requiring extensive corrective work such as patching or grinding and that formed concrete will conform to dimensional tolerances as follows.

B. Construct formwork to maintain tolerances required by ACI 301.

C. Tolerances: Construct formwork so that concrete surfaces shall be within construction tolerances specified in ACI 117.

D. Above tolerances do not relieve Contractor from responsibility of adhering to closer tolerances where required to coordinate concrete work with work of various trades or to achieve special architectural details.

END OF SECTION 031000

SECTION 032000 – CONCRETE REINFORCING

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 place reinforcing bars, stirrups, ties, bar supports, spacers, accessories, chairs, welded wire fabric, etc., as shown on the Drawings and as specified herein and as required to complete the work.

1.3 RELATED SECTIONS

A. Section 031000 – Concrete Forming and Accessories

B. Section 033000 – Cast-In-Place Concrete

1.4 QUALITY ASSURANCE

A. All work shall comply with provisions contained in the following documents (latest editions):

1. ACI 301 – Specifications for Structural Concrete
2. ACI 315 – Manual of Standard Practice for Detailing Reinforced Concrete Structures
3. ACI 318 – Building Code Requirements for Structural Concrete
4. ACI SP-66 – ACI Detailing Manual
5. CRSI – Manual of Standard Practice of the Concrete Reinforcing Steel Institute
6. ASTM A 615 – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
7. ASTM A 1035 – Standard Specification for Deformed and Plain Low-Carbon, Chromium Steel Bars for Concrete Reinforcement
8. ASTM A 185 – Standard Specification for Steel Welded Wire Reinforcements, Plain, for Concrete
9. ASTM A 775 – Standard Specification for Epoxy-Coated Steel Reinforcing Bars

1.5 SUBMITTALS

A. Shop Drawings: Indicate bar sizes, spacings, locations, and quantities of reinforcing steel and welded wire fabric, bending and cutting schedules, and supporting spacing devices.

B. Manufacturer's Certificate: Certify that products meet or exceeded specified requirements.

C. Certified copies of mill test reports of reinforcement material analysis.

1.6 COORDINATION

A. Coordinate with placement of formwork, formed openings and other Work.

PART 2 - PRODUCTS

2.1 REINFORCING MATERIALS

A. The form and size of bars shall be as shown on the Drawings.

B. Reinforcing steel shall conform to ASTM A 615. Bars shall be Grade 60, unfinished unless noted otherwise.

C. If required, epoxy coated reinforcement shall conform to ASTM A 775.

D. Wire fabric for reinforcement shall conform to ASTM A 185. Wire fabric shall be furnished in flat sheets not rolls.

2.2 ACCESSORIES

A. Tie wire for unfinished reinforcement shall be minimum 16 gage, annealed type, epoxy coated.

B. Tie wire for epoxy coated reinforcement shall be plastic coated 16-gauge black annealed wire.

C. Provide spacers, chairs, bolsters, supports, and other devices to properly space and support reinforcing bars and welded wire fabric, which are compatible with the waterproofing system.

D. Use plastic tipped accessories at exposed surfaces.

E. Epoxy coated reinforcing bars supported from formwork shall rest on coated wire bar supports or on bar supports made of dielectric material or other acceptable materials.

1. Wire bar supports shall be coated with dielectric material, compatible with concrete, for a minimum distance of 2 inches from the point of contact with the epoxy coated reinforcing bars.
2. Reinforcing bars used as support bars shall be epoxy coated.
3. In walls reinforced with epoxy coated bars, spreader bars shall be epoxy coated.
4. Proprietary combination bar clips and spreaders used in walls with epoxy coated reinforcing bars shall be made of corrosion-resistant material or coated with dielectric material.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Reinforcing steel shall be stored off the ground and protected from oil, or other deleterious materials. Epoxy coated reinforcing bars shall be stored on protective cribbing.

B. Clean oil, mud, loose rust and scale from reinforcing steel before concrete is placed.

C. Place in strict accordance with Drawings. Locate accurately in forms and hold firmly with approved supports and spacers to secure against displacement.

D. Use metal accessories to keep reinforcing clear distance from finish face of concrete surface as indicated on Drawings or required by applicable standards.

E. Do not displace or damage waterproofing membrane.

F. Accommodate placement of formed openings.

G. Cutting of bars shall be with mechanical saw only. Torch cutting will not be allowed.

H. Do not weld reinforcement unless noted on the Drawings.

I. Locate reinforcement splices not indicated on the Drawings, at point of minimum stress. Review location of splices with Designer.

J. Any epoxy coated bars cut or welded such that coating is damaged shall be field coated with epoxy to match shop coat.

K. Coating damage to epoxy coated reinforcing bars due to handling, shipment, and placing need not be repaired where the damaged area is 0.1 square inches or smaller; damaged areas larger than 0.1 inches shall be field coated with epoxy to match shop coat. The maximum amount of damage including repaired and unrepaired areas shall not exceed 2 percent of the total surface area in each linear foot of the bar.

L. Provide supervision during placing of concrete to watch reinforcing and reset any bars displaced by pouring operation.

M. For welded wire fabric lap adjoining pieces one full mesh and lace splices with 16-gauge wire. Offset end laps in adjacent widths to prevent continuous laps.

N. The Contractor shall notify the Construction Representative at least 36 hours before commencing to place concrete for any major portion of the work in order to permit inspection of the reinforcing.

END OF SECTION 032000

SECTION 033000 – CAST-IN-PLACE CONCRETE

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. Cast-in-place concrete and accessories associated with concrete work.

1.3 RELATED SECTIONS

A. Section 031000 – Concrete Forming and Accessories

B. Section 032000 – Concrete Reinforcing

1.4 REFERENCES

A. ACI 301 – Structural Concrete for Buildings

B. ACI 302 – Concrete Floor and Slab Construction

C. ACI 304R – Measuring, Mixing, Transporting and Placing Concrete

D. ACI 305R – Hot Weather Concreting

E. ACI 306.1 – Cold Weather Concreting

F. ACI 308 – Curing Concrete

G. ACI 318 – Building Code Requirements for Structural Concrete and Commentary

H. ASTM C 31 – Standard Practice for Making and Curing Concrete Test Specimens in the Field

I. ASTM C 33 – Concrete Aggregates

J. ASTM C 39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

K. ASTM C 94 – Ready-Mixed Concrete

L. ASTM C 150 – Portland Cement

M. ASTM C157 – Change of Hardened Hydraulic-Cement Mortar and Concrete

N. ASTM C 260 – Air Entraining Admixtures for Concrete

O. ASTM C 295 – Guide for Petrographic Examination of Aggregates for Concrete

P. ASTM C 309 – Liquid Membrane Forming Compounds for Curing Concrete

Q. ASTM C 457 – Microscopial Determination of Parameters of the Air-Void System in Hardened Concrete

R. ASTM C 494 – Chemicals Admixtures for Concrete

S. ASTM C 595M – Blended Hydraulic Cements (Metric)

T. ASTM C 618 – Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete

U. ASTM C 989 – Ground Granulated Blast-Furnace Slag for use in Concrete and Mortar

V. ASTM D 994 – Preformed Expansion Joint Filler for Concrete (Bituminous Type)

W. ASTM C 1017 – Chemical Admixtures for Use in Producing Flowing Concrete

X. ASTM C 1107 – Packaged Dry, Hydraulic Cement Grout (Nonshrink)

Y. ASTM C 1202 – Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration

Z. ASTM C 1240 – Silica Fume Used in Cementitious Mixtures

AA. ASTM C 1260 – Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)

BB. ASTM D 1752 – Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

CC. ASTM C 1567 – Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar Bar Method)

DD. ASTM D 6690 – Concrete Joint Sealer, Hot-Poured Elastic Type

1.5 SUBMITTALS

A. Product Data: Submit data for bonding agent, joint devices, attachment accessories, form release agents, curing compounds, coloring dye, etc.

B. Color samples for concrete coloring dye.

C. Manufacturer's Installation Instructions: Submit installation procedures and interface required with adjacent work.

D. Shop drawings for inserts.

E. Material Certificates: Submit mill certificates for the cement, supplementary cementitious materials, and admixtures intended for inclusion in the concrete mixtures.

1. Cement: Submit certification of compliance with ASTM C 150 for cement manufactured within 3 months of submittal date.
2. Fly Ash and Pozzolan: Submit certification of compliance with ASTM C 618 performed within 6 months of submittal date.
3. Ground Granulated Blast-Furnace Slag: Submit certification of compliance with ASTM C 989 performed within 6 months of submittal date.

4. Chemical Admixtures: Submit certificate of compliance with ASTM C 494 Level 1 or Level 2, performed within one year of the submittal date. If a chemical admixture does not fit into a defined C 494 type, admixture certificate shall provide documentation that the admixture has no detrimental effect on strength development, time of setting, shrinkage, air entrainment, scaling, and freeze-thaw resistance (ASTM C 666 Procedure A).

F. Project Record Documents:

1. Accurately record actual locations of embedded utilities and components that are concealed from view.
2. Submit upon request for record copies of all concrete delivery tickets.
3. Submit upon request for record copy of plan with locations and dates for concrete placements shown on drawing.

G. Aggregates: Submit test results for each aggregate intended for use in the concrete mixtures, showing conformance to ASTM C 33 and additional requirements as follows:

1. Aggregate source and identification
2. Maximum nominal aggregate size, gradation size number
3. Gradation analysis, including percentage retained and passing each sieve, and a graph of individual percentage retained versus sieve size
4. Quantity and identification of deleterious substances in the aggregates

    a. The limits for deleterious materials contained in coarse aggregate as defined in ASTM C 33 – Table 3 Class 4S.

5. Submit complete data regarding concrete aggregates prior to any change in aggregate source.

H. Concrete Mixture Submittal: At least 30 days minimum prior to concrete placement, submit mixture proportions and prequalification test data for each type of concrete along with material certifications. Submit complete list of ingredients including type, brand, source and amount of: cement, fly ash, ground-granulated blast-furnace slag, aggregates, and admixtures.

I. Construction Field Test Results: Fresh concrete properties, including slump, air content, temperature, and unit weight, and hardened concrete properties, such as strength, shall be measured and submitted for record.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 301.

B. Maintain one copy of each document on site.

C. Acquire cementitious materials and aggregate from same source contained in the submittals for all Work.

D. Conform to ACI 305R when concreting during hot weather.

E. Conform to ACI 306.1 when concreting during cold weather.

1.7 COORDINATION

A. Coordinate the placement of joint devices with erection of concrete formwork and placement of form accessories.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

A. Portland cement shall conform to ASTM C-150, and shall be Type I. High Early Strength Cement, Type III may be used only when authorized by Construction Representative.

B. Water shall be potable, clean, fresh and free from oil, alkali, organic matter or other impurities.

C. Fine aggregate shall be clean, coarse, washed river channel sand, free from loam, clay, lumps or other deleterious material, conforming to ASTM C33 "Specifications for Concrete Aggregate".

D. Coarse aggregate shall be clean, hard, washed, and screened river gravel or clean, hard limestone free from dust, flat friable or laminated particles and fine materials. Aggregate shall conform to ASTM C33. Coarse aggregate shall be well graded from fine to coarse. Size of coarse aggregate shall not exceed 3/4".

E. Flint and chert will be limited to 1% maximum, by weight of the course aggregate, in all exposed concrete (cast-in-place or precast). Lignite will be limited to 0.07%, by weight of the fine aggregate in all exposed concrete.

2.2 ADMIXTURES

A. Air Entrainment: ASTM C 260

B. Chemical: ASTM C 494, Type A - Water Reducing, Type B – Retarding, Type C – Accelerating, Type F - Water Reducing, High Range. Calcium chloride or accelerating admixtures containing calcium chloride shall not be used.

C. Fly Ash and Calcined Pozzolan: ASTM C 618

D. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 80, 100 or 120

E. Plasticizing: ASTM C 1017

F. Color additive: Solomon Grind-Chem Service, Inc. with a minimum concentration of 2 lbs per sack of cement, Davis Colors with a minimum concentration of 3 lbs per sack of cement, or Scofield with a minimum concentration of 2 lbs per sack of cement or approved equal. Submit color samples for Owner selection of best color to blend in with the cave floor.

2.3 ACCESSORIES

A. Bonding Agent: Polymer resin emulsion or Latex emulsion.

B. Non-Shrink Grout: ASTM C 1107, premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 2,400 pounds per square inch in 48 hours and 5,000 pounds per square inch in 28 days.

2.4 JOINT DEVICES AND FILLER MATERIALS

A. Joint Filler: ASTM D 1752; closed cell molded vinyl foam, resiliency recovery of 95 percent if not compressed more than 50 percent of original thickness.

B. Horizontal Joint Sealant: Multi-component Jet-Fuel-Resistant Urethane Sealant for Concrete - Pourable, chemically curing elastomeric formulation complying with the following requirements: Urethane Formulation - ASTM C-920, Type M; Grade P; Class 25; Uses T, M, A, and O as applicable to joint substrates indicated.

C. Vertical Joint Sealant: Multi-component Urethane Sealant for Concrete: Multi-component, gun grade urethane formulation complying with ASTM C 920 for Type M; Grade NS, Class 25, Uses T, M, and O as applicable to joint substrates indicated.

D. Joint-Sealant Backer Materials: Provide joint-sealant backer materials that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint sealant manufacturer based on field experience and laboratory testing.

E. Backer Strips for Cold Applied Sealants: ASTM D 1751; of thickness and width required to control sealant depths, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

F. Primers: Product recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint- sealant-substrate tests and field tests.

2.5 CONCRETE MIX

A. Comply with the concrete proportioning and test requirements included in Paragraph 3.15.

B. Mix concrete in accordance with ACI 301. Deliver concrete in accordance with ASTM C 94.

C. Select proportions for normal weight concrete in accordance with ACI 301 trial mixtures.

D. Optimize the combined aggregate gradation to minimize the paste content required to make workable concrete.

E. Use accelerating admixtures in cold weather only when approved by Construction Representative. Use of admixtures will not relax cold weather placement requirements.

F. Admixtures containing ingredients corrosive to reinforcing steel such as chloride ion, bromide ion, or thiocyanate are not permitted.

G. Use set retarding admixtures during hot weather only when approved by the Construction Representative.

H. Add air entraining agent to normal weight concrete mix for work exposed to exterior.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify requirements for concrete cover over reinforcement.

B. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not cause hardship in placing concrete.

3.2 PREPARATION

A. Prepare previously placed concrete surfaces by abrasive blast cleaning, to remove debris and laitance and expose aggregate. Thoroughly wet the substrate prior to placement of fresh concrete against prepared surface.

B. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels in an approved grout, epoxy, or adhesive.

3.3 PROPORTIONING

A. Concrete shall be proportioned in accordance with ACI 211.1, "Standard Practice for Selecting Proportions for Normal and Heavyweight Concrete".

B. Provide a concrete mix having not less than the specified minimum 28 days compressive strength using Type I cement and a consistency that can be worked into corners and angles of the forms and around joints, waterstops, dowels, tie bars, and reinforcement without excessive spading or vibration, segregation or undue accumulation of water or laitance on the surface.

C. Concrete mixtures which have been designed, approved and tested shall be adjusted in the field from time to time when required to meet the varying conditions encountered during construction and to maintain the specified strength, air, and slump requirements. Only water reducing admixtures or super plastics may be added. Addition of water is <u>not</u> permitted.

D. The strength level of the concrete shall be considered satisfactory if the averages of all sets of three consecutive strength test results equal or exceed the compressive strength requirements specified and no individual strength test result falls below the specified compressive strength by more than 500 psi. Each compressive strength test result shall be determined by finding the average compressive strength of three cylinders tested at the age of 28 days.

3.4 MIXING

A. Only ready mixed concrete shall be used. Ready mixed concrete shall be mixed and transported to the job site in accordance with ASTM C94 "Specifications for Ready Mixed Concrete".

B. Color additive shall be mixed throughout all concrete used inside the cave before it is poured into place. Do not add color additive to concrete after it has been poured into the formed area.

C. Discharge of the concrete from truck shall be completed within 90 minutes after the introduction of water to the cement. Discharge of concrete from a stationary truck body shall be within 45 minutes. The limitations above may be extended as approved by Construction Representative if the concrete can be placed without addition of water to the batch to meet slump and placing requirements. In hot weather, or under conditions contributing to quick stiffening of the concrete, the limitations above may be reduced as directed by Construction Representative.

D. Any concrete developing a set before being placed or requiring additional water to restore its consistency shall not be used.

3.5 PLACING CONCRETE

A. Place and consolidate concrete in accordance with ACI 301 and ACI 318.

B. Notify Construction Representative and testing agency a minimum of 24 hours prior to commencement of operations.

C. Ensure reinforcement, inserts, embedded parts, and formed expansion and contraction joints are not disturbed during concrete placement.

D. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

E. Place concrete continuously between predetermined expansion, control, and construction joints.

F. Do not interrupt successive placement; do not permit cold joints to occur.

G. Before placing concrete, inspect and complete the formwork installation, reinforcing steel, and items to be embedded or cast-in. Notify other crafts to permit the installation of their work; cooperate with other trades in setting such work, as required.

H. Water, wood scraps, paper and all foreign material shall be removed from the place of deposit before concrete is poured.

I. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness within the section. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as nearly as practicable to its final location to avoid segregation due to rehandling or flowing.

J. While the concrete is being poured, it shall be spaded, tamped and vibrated so as to thoroughly work it around all reinforcement and embedded items and into corners of forms and leave a dense smooth surface when the forms are removed. Vibrators shall not be used to move or transport the concrete inside the forms.

K. Special precautions shall be taken to avoid segregation of the concrete during handling and placing operations. Concrete shall be deposited through suitable chutes or in such manner as to avoid a drop of more than 5' at any point.

L. Do not place concrete on frozen ground. Do not place concrete during rain, sleet or snow unless adequate protection is provided and the Construction Representative approves.

M. Walking on concrete shall not be permitted for at least 24 hours after it has been placed in the forms and for such additional hours thereafter as the Construction Representative may direct.

3.6 HOT WEATHER PLACING

A. When hot weather conditions exist that would seriously impair the quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.

B. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90°F. Mixing water may be chilled, or chopped ice may be used to control the concrete temperature, provided that the water equivalent of the ice is calculated to the total amount of mixing.

C. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that the steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.

D. Wet forms thoroughly before placing concrete.

E. Do not use retarding admixtures unless otherwise accepted in mix designs.

3.7 COLD WEATHER PLACING

A. Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures in compliance with ACI 306 and as herein specified.

B. When air temperature has fallen to, or is expected to fall below 40°F, uniformly heat all water and aggregates before mixing as required to obtain a concrete mixture temperature of not less than 50°F and not more than 80°F, at point of placement.

C. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

D. Do not use calcium chloride, salt and other materials containing antifreeze agents or chemical accelerators, unless otherwise accepted in mix designs.

3.8 CONCRETE FINISHING

A. Formed surfaces shall have the following finishes unless otherwise noted on the Drawings.

1. Rough Form Finish: For formed concrete surfaces not exposed to view in the finish work and not receiving waterproofing membrane. This is the concrete surface having the texture imparted by the form facing material used, with tie holes and defective areas repaired and patched and fins and other projections exceeding 1/4" in height rubbed down or chipped off.
2. Smooth Form Finish: For formed concrete surfaces exposed to view, or that are to be covered with a coating, or covering material applied directly to the concrete, such as waterproofing, dampproofing, painting or other similar system. This is the as-cast concrete surface as obtained with selected form facing material, arranged orderly and symmetrically with a minimum of seams. Repair and patch defective areas with all fins or other projections completely removed and smoothed. Finish shall be Class A in accordance with ACI 347.
3. Related Unformed Surfaces: At tops of walls, horizontal offsets and similar unformed surfaces occurring adjacent to formed surfaces, strike-off smooth and plane and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise shown. Hand trowel tops of walls supporting precast concrete to a smooth, plane finish.

3.9 SLAB FINISHES

A. Slabs shall have following finishes unless otherwise noted on the Drawings:

1. Trowel Finish: Apply trowel finish to slab surfaces that are to be exposed to view and slab surfaces that are to be covered with resilient flooring, paint or other thin film finish coating system. Surface plane tolerance shall not exceed 1/8" in 10' when tested with a 10' straightedge. Grind smooth surface defects which would telegraph through applied floor covering system.
2. Float Finish: Apply a float finish to all roof slabs.
3. Non-Slip Broom Finish: Apply non-slip broom finish to exterior concrete sidewalks, platforms, steps and ramps, equipment pads, and elsewhere as shown on Drawings.

Immediately after trowel finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route.

B. Seal all interior concrete slab surfaces to be left exposed with hardener applied in accordance with manufacturer's specifications.

3.10 CURING AND PROTECTION

A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

C. Contractor shall have all equipment and material needed for curing and protection of the concrete on hand before actual concrete placement begins. The curing medium used shall be applied as soon as possible after placing to prevent checking and cracking and loss of moisture from all exposed surfaces of the concrete. Unhardened concrete shall be protected from heavy rains, flowing water, and mechanical injury (such as load stresses, heavy shocks, excessive vibration, and construction equipment, materials or methods).

D. Concrete surfaces not in contact with forms shall be cured by one of the following methods:

1. Ponding or continuous sprinkling.
2. Application of absorptive mats or fabric kept continuously wet.
3. Application of waterproof sheet materials conforming to ASTM C171.
4. Application of a curing compound conforming to ASTM C309 in accordance with the recommendations of the manufacturer. Curing compounds shall be compatible with waterproofing system.

E. Moisture loss from surfaces placed against wooden forms or metal forms exposed to heating by the sun shall be minimized by keeping the forms wet until they can be safely removed. After removal of the forms the concrete shall be cured until the end of the curing period specified below by one of the methods specified above.

F. Curing shall be continued for at least 7 days in the case of all concrete except high-early-strength concrete for which the period shall be at least 3 days. Alternately, if tests are made on cylinders kept adjacent to the structure and cured by the same methods, curing may be terminated when the average compressive strength has reached 70% of the specified strength. The cost of molding and testing the cylinders to determine this time shall be borne by Contractor.

G. Cold Weather: When the mean daily outdoor temperature is less than 40°F, the temperature of the concrete shall be maintained between 50°F and 70°F for the required curing period specified above. 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 without injury due to concentration of heat. Combustion heaters shall not be used during the first 24 hours unless precautions are taken to prevent exposure of the concrete to exhaust gases which contain carbon dioxide. Contractor shall provide a temperature recording device indicating the high and low temperatures within the enclosure during the entire curing period.

H. Hot Weather: When conditions are such that the rate of evaporation is greater than the rate at which water rises to the surface of recently placed concrete (i.e., high concrete temperature, high

air temperature, high wind, and low humidity, or combinations thereof), provision for wind breaks, shading, fog spraying, sprinkling, ponding, or wet covering with a light-colored material shall be made in advance of placement to prevent plastic shrinkage cracking. Such protective measures shall be taken as quickly as concrete hardening and finishing operations will allow.

I. Rate of Temperature Change: Changes in temperature of the air immediately adjacent to the concrete during the curing period shall be kept as uniform as possible and shall not exceed 5°F per hour or 20°F in any 24-hour period. After the curing period, changes in air temperature adjacent to the concrete shall not exceed 5°F per hour or 50°F in any 24-hour period.

J. Remove any curing materials containing waxes or other products that may interfere with adhesion of waterproofing membranes or coatings.

3.11 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed in accordance with ACI 301 by ACI certified technicians.

B. The Contractor will retain the services of a testing firm.

C. The Contractor shall be responsible for scheduling the tests.

D. Provide free access to Work and cooperate with appointed firm.

E. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of Work.

F. Concrete for casting test specimens and fresh concrete properties shall be sampled at the end of the chute in accordance with ASTM C 172.

G. No water other than the incidental water used to prewet the delivery chute and fins shall be added to the concrete after the truck leaves the batch plant, unless directed in writing by the Construction Representative.

H. Adjustment of slump on site shall only be accomplished by the addition of water reducing or plasticizing admixture. Admixture shall be placed directly onto the concrete and the revolving drum mixer shall mix at high speed for 5 minutes, or 100 revolutions, before discharge.

3.12 TESTS DURING CONSTRUCTION

A. The following sampling and testing shall be provided by the Contractor using an independent testing laboratory.

B. Sampling and testing for quality control during the placement of concrete shall include the following:

1. Slump: ASTM C143; one test for each set of compressive strength test specimens.
2. Compression Test Specimen: ASTM C31; one set of 4 standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field-cure test specimens are required.
3. Compressive Strength Tests: ASTM C39; one set for each 25 cu. yds. or fraction thereof, of each concrete class placed in any one day; one (1) specimen tested at 7 days, two (2) specimens tested at 28 days, and one (l) specimen retained in reserve for later testing if required.

4. Two additional test cylinders shall be cast during cold weather concreting and shall be cured on the job site under the same conditions as the concrete it represents. Compressive strength of field cured cylinders shall be determined prior to form removal, and at 56 days age.

C. Obtain concrete for casting test samples after slump adjustment.

D. Tests for fresh concrete properties (slump ASTM C 143, air content ASTM C 231, temperature ASTM C 1064, and unit weight ASTM C 138) shall be performed whenever casting test cylinders.

E. Additional fresh concrete property tests shall be performed when requested by the Construction Representative.

F. When the total quantity of a given class of concrete is less than 10 cu. yds., the strength test may be waived by the Construction Representative if, in his judgement, adequate evidence of satisfactory strength is provided.

G. When the strength of field-cured cylinders is less than 85% of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.

H. Test results will be reported in writing to the Construction Representative, Designer, and the Contractor on the same day that tests are made. Reports of compressive strength tests shall contain the project identification name, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in the structure, design compressive strength at 28 days, concrete mix proportions and materials; compressive breaking strength and type of break for both 7-day tests and 28-day tests.

I. The strength level of the concrete shall be considered satisfactory if the averages of all sets of three consecutive 28-day strength test results equal or exceed the compressive strength requirements specified and no individual strength test result falls below the specified compressive strength by more than 500 psi.

J. Concrete which fails to meet the minimum of 28-day strength requirements shall constitute questionable concrete. Contractor has the option of removing and replacing the questionable concrete or of making additional tests at his expense to prove the concrete strength is in compliance with the Specifications. Additional tests shall consist of core specimens taken where directed by Construction Representative and in accordance with ASTM C42. Concrete in the area represented by the core tests will be considered adequate if the average of three cores is at least 85% of the compressive strength specified and if no single core is less than 75% of the required compressive strength. If core tests fail to meet the minimum strength requirements, or if tests are required from which it is impractical to secure core samples in accordance with ASTM C42, then load tests may be made in accordance with ACI 318 Part 6, Chapter 20 to determine acceptability. Cost of this testing shall be borne by Contractor.

K. Concrete work failing to meet minimum strength requirements as determined by additional tests shall be removed and replaced as directed by Construction Representative at Contractor's expense.

3.13 INSERTS

A. Contractor shall provide all inserts and other cast-in-place items as shown and called for on the Drawings.

B. Steel plate and structural shapes shall be ASTM A36 and shall be shop cleaned and hot-dipped galvanized per ASTM A123 (minimum 2 oz/sq.ft.).

3.14 PATCHING

A. Allow Construction Representative to inspect concrete surfaces immediately upon removal of forms.

B. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify Construction Representative upon discovery.

C. Repair surface defects immediately after form removal. Surface defects include color and texture irregularities, honeycomb, rock pockets, voids over 1/4" in any dimension, spalls, ridges, and stains or discoloration that cannot be removed by cleaning.

D. Clean and thoroughly dampen tie holes and fill with patching mortar.

E. Remove ridges, honeycomb, rock pockets, voids, etc., down to solid concrete. Make edges of cuts perpendicular to the concrete surface. Before placing cement mortar or proprietary patching compound, thoroughly clean, dampen with water and brush-coat the area to be patched with neat cement grout, or proprietary bonding agent.

F. For surfaces exposed to view blend white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Compact mortar in place and strike-off slightly higher than surrounding surface.

G. If defects cannot be repaired, remove and replace concrete.

H. Use epoxy based mortar for structural repairs.

I. Patch imperfections in accordance with ACI 301.

3.15 DEFECTIVE CONCRETE

A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances, or specified requirements.

B. Remedy for defective concrete (payment penalty, repair, or replacement) will be determined by Construction Representative.

C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Construction Representative for each individual area. Repairs made shall be in accordance with ACI 301.

3.16 SCHEDULE - CONCRETE TYPES AND TEST REQUIREMENTS

Concrete shall be Class A as specified below.

Table 1 – Concrete Proportioning and Testing Requirements

Concrete Class	A
Materials and Proportions	
Cement, ASTM C 150	Type I/II
Supplementary Cementitious Materials, *cm*	50% max[†]
Maximum Aggregate Size	3/4 inch

Water-cementitious materials ratio, *w/cm*	0.40 max
Prequalification Requirements	
Aggregates	ASTM C 1260
Slump - ASTM C 143	6 to 8 in.
Chloride Content – ASTM C 1152	< 0.20% wt of cement
Air Content - ASTM C 231	6% to 8%
Hardened Air Content - ASTM C457	>6%
28-day Strength - ASTM C 39	4000 psi
Drying Shrinkage - ASTM C 157	Not Required
28-day Permeability – ASTM C 1202 Permeability	Not Required
Field Testing for Process Control	
Slump - ASTM C 143	6 to 8 in. at point of placement
Air Content - ASTM C 231	6% to 8%
28-day Strength - ASTM C 39	4000 psi
28-day Permeability – ASTM C 1202	Not Required

† Maximum combined supplementary materials content of ternary or quaternary blends. Limitations on supplementary materials shall include quantities contained in blended cement. Fly ash content shall not exceed 25%. Ground granulated blast-furnace slag content shall not exceed 45%.

END OF SECTION 033000

SECTION 260115 – PREVENTATIVE MAINTENANCE FOR 15kV METAL-CLAD SWITCHGEAR

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 as well as protective relay testing and calibration for the 12.47 kV campus main switchgear in accordance with the equipment manufacturers instruction manuals and industry standards.

1.3 RELATED SECTIONS

A. Section 012300 – Alternates

B. Section 260500 – Common Work Results for Electrical

C. Section 260573 – Protective Device Coordination Study and Arc Flash Risk Assessment

D. Section 262816.16 – Enclosed Switches

1.4 COORDINATION

A. It is the intent of the 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. Execute the work specified herein to occur during the building power outage work on the Maintenance Building, Physical Therapy Building and Donnely Building as indicated on the Drawings.

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 of 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 15 kV switchgear, vacuum circuit breakers, station batteries and battery charger.

F. Preventative Maintenance test reports

G. Product data for switchgear batteries and battery disconnect switch(es)

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
21.	NFPA 70B		Recommended Practice for Electrical Equipment Maintenance
22.	NFPA 70E		Standard for Electrical Safety in the Workplace
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 15kV 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/note book 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 – 100 amp
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 HiPotentional test set – 60 Hz
17. Hygro-thermometer
18. Hydrometer
19. Temperature correction chart for battery maintenance
20. Shopvac
21. Lock-out/Tag-out

1.8 ACCEPTABLE PROVIDERS

A. The preventative maintenance services for 15 kV metal-clad switchgear, vacuum circuit breakers and 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
   (314) 374-6190
   Tom Bush
3. Electric Power Systems
   21 Millpark Ct.
   Maryland Heights, MO 63043
   (314) 218-2745
   James Vaughn
4. Schneider Electric Services
   St. Louis, MO
   (314) 437-6987
   Andrea Wolfe

B. The15 kV metal-clad switchgear station battery replacement and preventative maintenance services on the battery charger shall be provided by one of the following:

1. Electrorep Energy Products, Inc
   2121 Schuetz Rd.
   St. Louis, MO 63146
   (314) 606-5225
   Stacey Hart
2. Engineered Power Systems
   48 Progress Parkway
   Maryland Heights, MO 63043
   (314) 220-5556
   Jeff Johnson
3. ALCAD
   (203) 985-2538
   Jason McShessrey

PART 2 - PRODUCTS

2.1 SWITCHGEAR BATTERIES

A. BASE BID

1. 12V thin plate pure lead-tin valve regulated lead acid with absorbent glass mat (VRLA AGM) type that uses a microporous separator to control gas emissions.
2. UL 94 V-0 flame retardant case and cover
3. M6 or 3/8-16 female no-maintenance terminals
4. Capable of being installed in any orientation except inverted
5. 400 cycles to 80% depth discharge
6. High rate charge and discharge
7. UL listed or UL recognized
8. "Maintenance free" except for periodic cleaning and functional testing
9. Genesis XE Series or approved equal by ALCAD or GNB-Stryten Energy

B. ALTERNATE BID NO. 2

1. Flat plate flooded batteries with 99.9% pure lead Planté positive plate with complimentary and robust negative flat plate or lead selenium (LSe) flat plate design
2. Low internal resistance due to high porosity separator material
3. Impact-resistant, transparent styrene acrylonitrile (SAN) jar allowing for an immediate inspection of electrolyte level
4. ABS plastic or SAN jar cover with service hole to permit quick and easy measurements of the electrolyte density
5. Porous flameproof vent plug with flame arresting cap
6. Metallic threaded insert on terminals to ensure the highest conductivity
7. Deep discharge capability (>1,000 cycles)
8. 2.23 V/cell at 20° float voltage and 2.40 V/cell equalize voltage
9. FIAMM SGL or approved equal by ALCAD, GNB-Stryten Energy or MESA

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. Revised power system study 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/devices being tested
6. Site safety rules and emergency procedures
7. Site electrical one-line diagram (Project Drawing E-601)
8. Site 12.47 kV equipment schedules (Project Drawing E-604)

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. Perform switching of existing S&C pad-mounted switchgear as necessary to isolate the 15 kV metal-clad switchgear to be serviced and to connect temporary generators as specified in Section 260500 - Common Work Results for Electrical. Contractor shall be responsible for the switching of all equipment and circuit breakers. The Owner does not have personnel on site to operate 12.47 kV switches or circuit breakers.
2. Open the 2000A site emergency generator output circuit breaker inside the generator enclosure.
3. Apply lock-out/tag-out to all open switches and circuit breakers.
4. Contact Ameren Missouri for disconnection of both incoming utility feeders to the 15 kV metal-clad switchgear and apply safety grounds on both main breaker sections of the switchgear. NOTE: Ameren Missouri may choose to apply their own safety grounds.

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 counter readings 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 15 kV metal-clad switchgear line-up including all circuit breakers and accessories for:

    a. Loose or obviously damaged components
    b. Proper identification
    c. Proper application of the circuit breakers with the cells
    d. Compliance with switchgear drawings
    e. Doors, panels, and sections for alignment, dents, scratches, fit and missing hardware
    f. 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 Article 250 of the NEC
    c. Insulators for evidence of physical damage or contaminated surfaces
    d. Surge arrester and surge capacitor size, type, installation and connection to verify compliance with the switchgear drawings, the latest edition of Ameren Missouri Specification CE-10 and Article 242 of the NEC
    e. Breaker cells, primary and secondary disconnects for physical condition, cleanliness and lubrication.
    f. Alignment and penetration of instrument transformer withdrawal disconnects, current carrying, and grounding components
    g. Control power transformers for damage and visible signs of stress or overheating
    h. Wiring for damaged insulation, broken leads, tightness of connections, proper crimping, and overall general condition
    i. Structure, grounding, cables and bus assembly
    j. Proper operation of switchgear walk-in enclosure lighting fixtures, emergency lights, convenience receptacles and air conditioning system

        i. Verify the grounding electrode conductor is properly sized in accordance with Article 250 of the NEC and is properly terminated.
        ii. Verify the proper grounding of instruments, panels, and connections per Article 250 pf the NEC.
        iii. Verify that conductors are properly identified.
        iv. Verify cable termination tightness to manufacturer’s published values by calibrated torque wrench.
        v. Verify integrity of insulation on bus bars and cable to bus connections.
        vi. Verify tightness of accessible bolted electrical connections by calibrated torque wrench in accordance with manufacturer’s published values.
        vii. Verify correct barrier and shutter installation and operation.
        viii. Verify that filters are in place and/or vents are clear from obstructions.

    k. Control and instrumentation:

        i. Verify that all PT (VT) and CT ratios properly correspond to drawings and that polarity is correct.

ii. Verify that shorting screws and bars are removed from CT's and terminal blocks as required.
iii. Verify the primary and secondary fuse ratings or circuit breakers match the switchgear drawings.
iv. Verify meter scaling and type match the switchgear drawings.
v. Verify that circuit breaker and meter addresses are set for microprocessor-communication packages.
vi. Verify that accessible moving components are adequately lubricated per the equipment manufacturer's recommendations.

l. Key Interlock Systems

i. Verify key number and exchange codes.
ii. Verify proper sequencing to comply with switchgear drawing notes.
iii. Attempt to close locked-open devices.
iv. Attempt to open locked-closed devices.
v. Make key exchange with devices operated in off-normal positions.
vi. Disposition of duplicate keys found shall be per the Owner's safety policy.

m. With breaker open, inspect:

i. Primary leads, insulators, and disconnects
ii. Ground contact, secondary disconnect, close and trip interlocks, levering latch, MOC and TOC operators, and all other interlocks

n. Verify manual operation of breaker

i. Charge closing spring using maintenance tool (manual charge handle), then remove handle.
ii. Verify Charged/Discharged status indicators function properly.
iii. Close breaker manually and verify Closed and Discharge indicator.
iv. Charge breaker again and verify that the breaker stays closed.
v. Trip breaker manually and verify Open indicator.
vi. Repeat several times to confirm mechanism operates consistently and reliably.
vii. Charge closing spring and close manually.

o. With breaker closed:

i. Inspect contact erosion indicator mark on vacuum interrupter moving stem.
ii. Inspect contact wipe ("T" Slot).
iii. Measure contact resistance using a 100 amp DC source and compare with previous results if information is available.
iv. Perform "CLOSED" portions of AC high potential test (vacuum integrity test).
v. Open breaker

p. With breaker open:

i. Perform the "OPEN" portion of AC high potential test.
ii. 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.

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.

q. Perform control wiring AC high potential test at 1,125V RMS. **Do not perform this test on wiring connected to solid state components.**
r. 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.
s. Verify the proper operation of all breakers/cell accessories, shutters, auxiliary switches, cell MOC and TOC switches, key interlocks, and cell status indicators.
t. Verify the proper operation of all breaker/cell interlocks:

i. Maintenance interlock
ii. Levering interlock
iii. Positive interlock
iv. Negative interlock
v. Positive closing interlock
vi. Extension rail interlock
vii. Breaker/cell rating code interlock
viii. All other devices

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. Control and Instrumentation:

a. Perform the following tests on control power transformers:

i. Insulation-resistance tests. Perform measurements from winding-to-winding and each winding-to-ground. Test voltages shall be as specified by the equipment manufacturer.
ii. Verify correct secondary voltage by energizing primary winding with system voltage. Measure secondary voltage with the secondary winding connected.
iii. Perform secondary wiring integrity test. Confirm potential at all devices.
iv. Verify correct function of control transfer relays located in switchgear.
v. Verify operation of switchgear anti-condensation space heaters.

b. Perform the following tests on potential transformers:

i. 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.

ii. Verify correct secondary voltage by energizing primary winding with system voltage. Measure secondary voltage with the secondary winding connected.
iii. Perform secondary wiring integrity test. Confirm potential at all devices.

c. Perform the following tests on current transformers:

i. Ratio
ii. Saturation

3. Protection devices:

a. Verify settings for all protective relays per the revised power system study 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.

4. 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.

E. As a minimum, perform the following inspections and testing on the switchgear battery charging system:

1. Visual and mechanical inspection

a. Inspect for physical and mechanical condition.
b. Inspect anchorage, alignment, and grounding.
c. Prior to cleaning the unit, perform as-found tests.
d. Clean the unit.
a. Inspect bolted electrical connections for high resistance using one or more of the following methods:

i. Using a low-resistance ohmmeter
ii. Verify tightness of accessible bolted connections by calibrated torque-wrench in accordance with the battery manufacturer's published data.
iii. Perform thermographic survey under load.

b. Inspect filter and tank capacitors.
c. Verify operation of cooling fans. Clean filters if provided.
d. Verify location and condition of temperature compensation sensor.

2. As-Left electrical tests

a. Perform resistance measurements through all bolted connections with a low-resistance ohmmeter.
b. Measure and record float voltage and equalize voltage levels. Adjust to battery manufacturer's recommended settings.
c. Verify high-voltage shutdown settings.
d. Verify current limit.
e. Verify calibration of meters.
f. Verify charger temperature compensation is working correctly.
g. Verify operation of alarms, both local and remote.
h. Measure and record input and output voltage and current.
i. Measure and record AC ripple current and/or voltage imposed on battery.
j. Perform full load testing of charger.

3. Test values – Visual and Mechanical

a. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
b. Bolt-torque levels should be in accordance with the manufacturer's published data.

4. Test values – Electrical

a. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
b. Float and equalize voltage settings should be in accordance with the battery manufacturer's published data.
c. Current limit should be within manufacturer's recommended maximum value.
d. Results of alarm operation should be in accordance with manufacturer's published data and system design.
e. Input and output voltage should be in accordance with manufacturer's published data.
f. AC ripple current and/or voltage imposed on the battery should be in accordance with manufacturer's published data.
g. Charger should be capable of manufacturer's specified full load.

5. Perform the following after completion of battery system and charger testing:

a. 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.
b. Apply a test sticker that includes name of testing firm date and initials of technician on each battery rack and the battery system charger.
c. Review and organize all test results into a report with cover that includes the project information and a table of contents.

3.3 SWITCHGEAR BATTERY INSTALLATION

A. The required battery capacity is to be determined by the battery supplier based on the switchgear load information provided by the Owner. The original batteries furnished in the switchgear were ALCAD SGL 7D with 84Ah nominal capacity. An additional 12.47kV generator circuit breaker, identical to all other circuit breakers in the switchgear, was added to the switchgear since it was originally installed.

B. For the Base Bid VRLA AGM battery installation, provide two parallel strings of four (4) series connected batteries, each rated for the full switchgear 48VDC load, for redundancy. Install the first set of batteries and then install the second set of batteries 2 years latter such that the battery replacement cycles will be offset to increase reliability of the system.

C. Install batteries in existing racks inside the existing dedicated battery section of the 12.47kV campus main switchgear.

D. Provide and install battery inter-cell and inter-row connectors/connections as required and torque connections to manufacturer's specifications using a calibrated torque wrench.

E. Provide and install a fusible heavy-duty disconnect switch, in accordance with Section 262816.16 – Enclosed Switches for each battery string; two (2) required for the base bid battery installation

and one (1) required for the Alternate Bid No. 2 battery installation. Switch and fuse sizes are to be determined by the battery supplier based on the battery amp-hour rating.

F. Provide battery cables of the appropriate size from each battery string to each disconnect switch.

G. Utilize the Owner's existing four (4) 12V deep cycle batteries to maintain 48VDC power to the switchgear during installation of the new battery system.

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 and electrical work performed under Division 33 – Utilities.

1.3 RELATED SECTIONS

A. Division 3 – Concrete

B. Division 31 – Earthwork

C. Division 33 - Utilities

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. 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.	AEIC	Association of Edison Illuminating Companies
3.	AHDGA	American Hot Dip Galvanizers Association, Inc.
4.	AISC	American Institute of Steel Construction
5.	ANSI	American National Standards Institute
6.	ASA	American Standards Association
7.	ASTM	American Society for Testing & Materials
8.	AWS	American Welding Society
9.	BOCA	Building Officials and Code Administrators International, Inc.
10.	CSA	Canadian Standards Association
11.	EEI	Edison Electric Institute
12.	EIA	Electronics Industries Association
13.	ETL	Electrical Testing Laboratories, Inc.
14.	FMRC	Factory Mutual Research Corp
15.	IACS	International Annealed Copper Standard
16.	IBC	International Building Code
17.	IBEW	International Brotherhood of Electrical Workers
18.	ICC	International Code Council
19.	ICEA	Insulated Cable Engineers Association

20.	IEC	International Electrotechnical Commission
21.	IEEE	Institute of Electrical and Electronics Engineers
22.	IESNA	Illuminating Engineering Society of North America
23.	IFC	International Fire Code
24.	JIC	Joint Industrial Council
25.	NBFU	National Board of Fire Underwriters
26.	NEC	National Electrical Code (NFPA 70)
27.	NECA	National Electrical Contractors Association
28.	NEMA	National Electrical Manufacturers Association
29.	NESC	National Electrical Safety Code
30.	NETA	InterNational Electrical Testing Association
31.	NFPA	National Fire Protection Association
32.	NIST	National Institute of Standards and Technology (formerly National Bureau of Standards, NBS)
33.	OSHA	Occupational Safety and Health Administration
34.	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 2023 edition of the National Electrical Code (NEC) NFPA-70 and the latest version of the National Electrical Safety Code (NESC).

C. The Contractor shall keep a copy of the 2023 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. The Contract Drawings 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 any building or structure. Coordinate work to avoid interferences between other systems or between conduit, piping, equipment or structural or architectural elements of any building or structure.

C. Coordinate with work indicated on the Drawings with site conditions.

D. Drawings are based on preliminary information obtained from the 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, panelboards, enclosed circuit breakers, enclosed switches, electrical enclosures, 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.

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 on all exposed sides 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. Where existing equipment pads are being expanded, match the height of the existing concrete pad.

G. Equipment pad reinforcement shall conform to the requirements of Division 03 of these Specifications. Provide 6x6 – W1.4xW1.4 welded wire fabric or size 4 reinforcing steel rods placed 12 inches on center each direction, midway between the top and bottom of indoor equipment pads and size 4 reinforcing steel rods placed 12 inches on center each direction, midway between the top and bottom of outdoor equipment pads. Keep all reinforcement clear from pad edges all around by 1.5 to 2 inches.

H. Roughen existing concrete below new equipment pads and apply epoxy bonding agent before pouring new pads. Where existing equipment pads are being expanded, dowel to adjacent existing concrete pad using size 4 reinforcing steel rods on 12-inch centers no closer than 4” to edge of pad. Dowel embedment in existing and new pads shall be a minimum of 6 inches.

I. 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).

J. Anchor bolts shall be sized and located in accordance with the equipment manufacturer’s shop drawings and/or seismic installation instructions.

K. Anchor bolts 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 Division 26 and electrical work under Division 33 of the Specifications includes, but is not limited to, the following items:

1. Demolition of existing power and branch circuit conductors, cables, raceways, boxes, and equipment
2. Disconnection, handling, relocation and/or reconnection of existing equipment and electric power and rerouting of existing circuits and feeders as required and as shown on the Drawings
3. Removal and disposal off site of the existing equipment and materials to be removed
4. All feeder and branch circuit wiring and raceways
5. Grounding and bonding
6. Junction and pull boxes
7. Protective device coordination study and arc flash risk assessment
8. Dry-type, medium-voltage transformer
9. Pad-mounted, liquid-filled, medium-voltage transformer
10. Panelboards and circuit breakers
11. Enclosed circuit breakers
12. Enclosed switches and fuses
13. Across-the-line motor controllers and fuses
14. Medium-voltage outdoor sectionalizing cabinets
15. Medium-voltage wiring
16. Medium-voltage pad-mounted switchgear

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 and 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/grade to the top of the enclosure.

Item		Mounting Height
1. Panelboards		
a.	< 5'-8" tall enclosure	6 feet 0 inches
b.	≥ 5'-8" high enclosure	Install on 3.5" high concrete equipment pad per Article 2.3 of this Section
2. Enclosed circuit breakers		6 feet 0 inches
3. Enclosed switches		
a.	30-60-100A	5 feet 6 inches
4. Combination motor controllers		
a.	NEMA Size 0, 1 and 2	5 feet 6 inches

C. Any item 5 feet 8 inches high and larger shall be floor mounted on a 3-1/2 inch high concrete equipment pad in accordance with Division 3 and Article 2.3 of this Section, unless otherwise indicated.

D. Any item containing a disconnect switch or circuit breaker shall be mounted in such a way that the center of the grip of the operating handle of the switch or circuit breaker, when in its highest position, is not more than 6 feet, 7 inches above the floor or working platform, including the height of the housekeeping pad, if one is installed.

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. Under no circumstances shall any structural members, load bearing walls, building columns or footings be cut without first obtaining written permission from the Designer.

C. 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.

D. 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 requirements.

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 damaged due to 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 Division 26 and Division 33:

1. Section 260115 – Preventative Maintenance for 15kV Metal-Clad Switchgear
2. Section 260526 – Bonding and Grounding for Electrical Systems
3. Section 261216 – Dry-Type, Medium-Voltage Transformers
4. Section 261219 – Pad-Mounted, Liquid-Filled, Medium-VoltageTransformers
5. Section 262416 – Panelboards
6. Section 262913.13 – Across-the-Line Motor Controllers
7. Section 337710 – Medium-Voltage Pad-Mounted Switchgear

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 Bellefontaine Habilitation Center is a 24/7 live-in care facility for developmentally disabled individuals 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 12.47 kV power to the facility. The facility has a standby emergency diesel-engine generator that provides backup power for the entire facility. However, the generator is connected to the same 12.47 kV campus main switchgear (CMSWGR) as the two incoming utility feeders so no power will be available to the facility when work is taking place that requires that the 12.47 kV CMSWGR be de-energized.

C. During all times when the 12.47 kV CMSWGR must be de-energized for more than 3 consecutive hours for any reason during execution of the Work, temporary gasoline or diesel-engine generators must be provided on campus as follows:

D. CMSWGR lighting, convenience receptacles, battery charger and site emergency generator enclosure lighting, convenience receptacles, and battery charger – 208Y/120V, 3-phase generator to be provided by Contractor. Connect to line side of 150A main circuit breaker in Panelboard LPSG inside CMSWGR walk-in enclosure after disconnecting secondary leads from the switchgear control power transformer. Size generator as required to serve the connected load, approximately 8 to 10 kW, field verify.

E. Street Lighting - 25kW, 480Y/277V, 3-phase generator to be provided by Contractor. Connect to secondary leads after disconnecting at transformer T-1. NOTE: This generator is only required when a facility power outage occurs during times when the street lighting would normally be in operation.

F. Apartments – 100 kW, 120/240V, 1-phase trailer mounted generator provided by Owner. Connect to secondary leads after disconnecting at transformer T-11.

G. Warehouse/Food Distribution, Maintenance, Garage – 200 kW, 208Y/120V, 3-phase generator to be provided by Contractor. Connect to secondary side of transformer T-15 and back feed medium-voltage loop #2.

H. Remainder of the facility – 300kW, 208Y/120V, 3-phase generator to be provided by Contractor. Connect to secondary side of transformer T-DP/GH and back feed medium-voltage loop #3.

I. The Contractor shall be responsible for furnishing the four (4) generators noted in Items D, E, G, and H above along with cables and all other items required to connect all five (5) generators noted above.

J. The Contractor shall be responsible for furnishing all fuel for all generators.

K. Use of temporary generators to power 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.

L. The Contractor shall have a person knowledgeable in the operation of the temporary generators on site at all times when one or more temporary generators 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 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.

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.

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:

1. Power fuses removed from existing medium-voltage pad-mounted switchgear.

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 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 multiconductor control cable

B. Submit test report indicating results for copper wire and cable continuity and resistance 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 90ºC 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 in an underground or below a floor slab conduit and all service entrance conductors from a transformer to the 208Y/120V service disconnect 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 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

2.4 600-VOLT CONNECTIONS AND TERMINATIONS

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

2.5 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^2. 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-Volitle 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.

G. Swab the inside of conduit and raceways to ensure 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" power circuits from "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 WIRING CONNECTIONS AND TERMINATIONS

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

3.4 FIELD QUALITY CONTROL

A. General:

1. Testing shall be performed in the presence of the 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-bolt connectors 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
   (314) 374-6190
   Tom Bush
3. Frank Sager & Son, Inc.
   4754 Theiss Road
   St. Louis, MO 63128-2349
   Mark Rodgers
   (314) 892-7550
4. Schneider Electric Services
   St. Louis, MO
   (314) 437-6987
   Andrea Wolfe

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

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, in cable vaults, handholes, manholes & in the Physical Therapy Building Pool Mech/Elec Room: 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, in cable vaults, handholes, manholes & in the Physical Therapy Building Pool Mech/Elec Room: Type 304 stainless steel

E. *Flat Washers:*

1. Indoors: Cadmium plated steel

2. Outdoors, in cable vaults, handholes, manholes & in the Physical Therapy Building Pool Mech/Elec Room: Type 304 stainless steel

F. *Lock Washers:* ANSI medium, spring type

1. Indoors: Cadmium plated steel

2. Outdoors, in cable vaults, handholes, manholes & in the Physical Therapy Building Pool Mech/Elec Room: 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, in cable vaults, handholes, manholes & in the Physical Therapy Building Pool Mech/Elec Room: 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, in cable vaults, handholes, manholes & in the Physical Therapy Building Pool Mech/Elec Room: Type 304 stainless steel

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, in cable vaults, handholes, manholes and the Physical Therapy Building Pool Mech/Elec Room shall be 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, in cable vaults, handholes, manholes & in the Physical Therapy Building Pool Mech/Elec Room: Type 304 stainless steel

2.4 THREADED ROD STIFFENERS FOR SEISMIC SUPPORTS

A. Stiffeners for treaded rods used for seismic support shall be B-Line SC228 or SC-UB or approved equal by Unistrut Corporation, Kindorf Electrical Products Co. or 12-gauge, 1-5/8"x1-5/8" U-channel per Paragraph 2.3 A for hanger rods longer than 12-inches.

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:

1.

Bolt Diameter, in.	Embedment, in.
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 panelboards and transformers are to be the maximum diameter that will fit through the factory provided holes in the equipment base with a minimum of embedments shown above in the concrete floor below the concrete housekeeping pad. Provide Belleville washers or square U-channel support washers per the equipment manufacturer's installation instructions for seismic restraint and where the enclosure bottom is sheet metal with no structural members.

C. Use factory installed external mounting tabs for mounting electrical equipment and electrical enclosures that are NEMA Type 4X. Drilling a mounting hole in a NEMA 4X rated enclosure will void its UL Listing and NEMA rating and will require that the enclosure be replaced.

D. 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.

E. Utilize toggle bolts, hollow wall fasteners or through-wall bolt fasteners for attachment of electrical equipment, boxes and raceways to hollow masonry surfaces.

F. Utilize machine screws for attachment of electrical equipment, boxes and raceways to metal surfaces.

G. Nails shall not be used as a means of fastening.

H. Do not use spring steel clips.

I. 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).

B. All floor mounted 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. Provide stiffeners on all treaded rods used for seismic support as specified herein.

E. Transverse and longitudinal braces shall be no more than 45° above or below the centerline of the conduit.

F. 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.

G. Seismic bracing shall not limit the expansion and contraction of the conduit system.

H. The Contractor shall field locate bracing as required unless otherwise shown on the Drawings.

I. 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.

J. Detailed design and installation of all electrical conduit supports and seismic restraints shall be the Contractor's responsibility.

K. Provide seismic-restraints complying with the requirements of applicable Building Codes, 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).

L. 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 260500 – Common Work Results for Electrical

C. Section 260519 – Low-Voltage Electrical Power Conductors and Cables

D. Section 260526 – Grounding and Bonding for Electrical Systems

E. Section 260529 – Hangers and Supports for Electrical Equipment

F. Section 260533.16 – Boxes for Electrical Systems

G. Section 260553 – Identification for Electrical Systems

H. 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, liquidtight flexible nonmetallic, rigid nonmetallic)
2. Conduit hubs
3. Anti-corrosion thread sealant
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

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, in cable vaults, handholes, manholes, inside the Physical Therapy Building Pool Mech/Elec Room and inside the Maintenance Building Main Electrical Room.

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 used with stainless steel fittings, enclosures or boxes.

      4) Rigid aluminum conduit shall not be installed in locations or environments known to be corrosive to aluminum such as the Physical Therapy Building Pool Mech/Elec Room.

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, unless rigid metal conduit is called out elsewhere in this specification or on the Drawings

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 where a flexible conduit connection is required except that it shall not be used in the Physical Therapy Pool Mech/Elec Room.

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 Liquatite

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. Flexible metal conduit ("greenfield") 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) As permitted elsewhere in these Specifications or Drawings.

3) LFMC shall not be used in the Physical Therapy Building Pool Mech/Elec Room

5. Liquidtight flexible nonmetallic conduit (LFNC) shall be constructed with rigid polyvinyl chloride (PVC) reinforcement imbedded within a flexible PVC making the conduit impact-resistant, crush-resistant, highly flexible, moisture-proof, oil-resistant, and sunlight resistant. The interior finish shall be smooth for ease of wire pulling. Liquidtight flexible nonmetallic conduit shall meet the requirements of NEC Article 356 and shall be UL Listed to UL 1660. Liquidtight flexible nonmetallic conduit shall only be used for motor connection located in the Physical Therapy Pool Mech/Elec Room.

   a. Minimum conduit size shall be 1/2-inch and maximum size shall be 1-inch.

   b. Minimum temperature range shall be -20°C (-4°F) to +80°C (+176°F) dry, +60°C (+140°F) wet.

   c. Connectors and fittings shall be UL Listed for use with liquidtight flexible nonmetallic conduit.

   d. Acceptable manufacturers:

      1) Southwire Ultratite Type NM

      2) ABB Thomas & Betts Carlon Carflex

      3) Electri-Flex Liquatite Type NM

6. Rigid nonmetallic 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 nonmetallic 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 nonmetallic 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 grounding type, insulated throat, liquid-tight:

1. Zinc plated steel or malleable iron for terminating rigid galvanized steel conduit in painted steel NEMA 12 electrical equipment enclosures and in painted steel or galvanized steel junction and pull boxes and wireways

2. “Copper free” aluminum for terminating rigid aluminum conduit in painted steel NEMA 12 electrical equipment enclosures and in painted steel or galvanized steel junction and pull boxes and wireways

3. Type 304 or 316 stainless steel for terminating rigid galvanized steel conduit at stainless steel electrical equipment enclosures, junction and pull boxes and wireways

B. Provide with a ground lug/screw on the lock nut.

C. Conduit hubs shall be Myers Type STG, STAG or SSTG Scru-Tite or approved equal.

D. Provide Fluoramics LOX-8, or approved equal, anti-corrosion thread sealant at threaded galvanized rigid steel conduit connections to stainless steel conduit hubs for compliance with NEC 344.14.

2.3 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 at the factory 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 (non-segmented type), 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.

2.4 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.

2.5 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).

2.6 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.

2.7 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

2.8 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.

2.9 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.

2.10 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.

2.11 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.

2.12 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 shall be 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.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Special requirements for materials to be used in the Physical Therapy Pool Mech/Elect Room: Only rigid galvanized steel (heavy-wall) conduit with stainless steel grounding type conduit hubs, stainless steel u-channel supports and conduit clamps, hot-dipped galvanized malleable iron conduit bodies and liquid tight flexible nonmetallic conduit shall be used. Electrical metallic tubing, rigid aluminum conduit, liquidtight flexible metal conduit and aluminum conduit bodies shall not be used in this area due to the corrosive atmosphere from the presence of chlorine.

B. 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 except that for rigid galvanized steel conduit connections to stainless steel conduit hubs, apply Fluoramics LOX-8, or approved equal, anti-corrosion thread sealant to the threads for compliance with NEC 344.14.

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, switchgear or transformer, 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. Identify all conduit runs; both new conduit and existing that is reused, in accordance with Section 260553 – Identification for Electrical Systems.

32. 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.

33. 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.

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 or cable vault 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 with corrosion protection applied as specified herein.

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 UNDERGROUND UTILITIES

A. 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.

B. Before any excavations are begun, the Contractor shall communicate with the Owner and obtain, if possible, the exact location of any privately underground structures or utilities located in the vicinity of the excavation.

C. Existing underground utilities shown on the Drawings are based on available record documents obtained from the Owner, but their accuracy is generally unconfirmed. Existing underground utilities in the areas of construction are believed to be private and therefore, will not be located by the Missouri One Call program. Obtain field utility locates from a private utility locate company prior to performing any excavation work.

D. 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.

E. 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.

F. 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

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. Dimensioned junction and pull boxes
3. Wireways and wire troughs

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, Raco, 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 and in the Physical Therapy Building Pool Mech/Elec Room shall be cast, cadmium or zinc plated malleable iron, 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 in indoor dry areas 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 in the Maintenance Building Main Electrical Room shall be painted steel, galvanized steel or code gauge sheet aluminum, NEMA Type 12 having removable neoprene gasketed cover fastened with cadmium plated, galvanized or stainless-steel screws, and continuously welded seams (ground smooth) with no holes or knockouts.

E. Dimensioned junction and pull boxes located outdoors, above grade, inside cable vaults or in the Physical Therapy Building Pool Mech/Elec Room 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. Boxes shall have an external mounting tab at each corner as no holes can be field drilled in the box for mounting purposes.

F. 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.

G. Provide hinged cover enclosures for any box larger than 12 inches in any dimension.

H. 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.

I. Inner Back Panels: Provide white painted steel, galvanized steel, code gauge sheet aluminum or stainless steel inner back panel, to match box construction, inside all boxes in which terminal blocks or control devices are located.

2.3 WIREWAYS & WIRE TROUGHS

A. All wireways and wire troughs, including covers and other accessories, shall be UL Listed and Labeled.

B. Wireways and wire troughs shall be sized as per the NEC or as shown on the Drawings.

C. Wireways and wire troughs located outdoors, in cable vaults or in the Physical Therapy Building Pool Mech/Elec Room shall be minimum 14-gauge Type 304 or Type 316 stainless steel, NEMA Type 4X having continuously welded seams (ground smooth) with no holes or knockouts and an oil-resistant gasketed 14-gauge Type 304 or Type 316 hinged cover secured with a minimum of four (4) Type 304 or Type 316 stainless-steel screw clamps. The cover hinge shall be a continuous stainless steel piano hinge with removable stainless steel pin.

D. Wireways and wire troughs shall be sized as indicated on the Drawings in accordance with NEC Article 314-16 or 314-28 as a minimum.

E. Provide external mounting tabs on both sides of the long dimension of wireways and wire troughs for securing to the mounting surface as no holes can be field drilled in the enclosure for mounting purposes.

F. Wire troughs shall be as manufactured by Appleton Electric Company, Eaton Crouse-Hinds, E-Box, Hoffman Engineering Company, Hubbell-Wiegmann, or approved equal.

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, transformers, 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 and pull boxes 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.

19. Where strain relief is required within a dimensioned junction or pull box, such as to prevent the conductors/cables within from pressing against the box cover/door, provide fiberglass U-channel supports for support. Do not install wooden support members within any box.

3.2 WIREWAY & WIRE TROUGH INSTALLATION

A. Locate and install wireways and wire troughs to allow access and to present a neat appearance.

B. Special care shall be taken to set wireways and wire troughs square and true with the building or cable vault finish.

C. Wireways and wire troughs shall be rigidly mounted to the building or cable vault structure, independent of the connected conduits, at all four corners of the enclosure using the factory provided external mounting tabs.

D. All conduits shall enter wireways and wire troughs through properly sized round holes cut with a punch and die.

E. All open conduit knockouts, holes, or unused hubs in wireways and wire troughs shall be properly plugged with suitable blanking devices of the same material as the enclosure that maintain the NEMA rating of the enclosure. Utilize gasketed stainless steel blanking devices for stainless steel wireways and wire troughs. Utilize NEMA 12 rated hole seal devices to seal all open holes in the top of all panelboards, switchboards, and dimensioned junction and pull boxes located indoors.

F. Rigid metal conduits terminating in all NEMA Type 4X wireways and wire troughs shall be terminated in stainless steel insulated throat, grounding type, liquid tight, rigid conduit hubs. Conduit hubs shall be provided in accordance with Section 260533.13 – Conduit for Electrical Systems.

G. All wireways and wire troughs with a hinged cover shall be installed such that the cover can be opened at least 90 degrees.

H. Wireways and wire troughs with a hinged cover that are mounted horizontally on a wall shall be mounted such that the cover opens down rather than upwards.

I. Where strain relief is required within a wireway or wire trough, such as to prevent the conductors/cables within from pressing against the cover, provide fiberglass U-channel supports for support. Do not install wooden support members within any wireway or wire trough.

3.3 CIRCUIT IDENTIFICATION

A. Junction, pull, outlet boxes and wireways shall be identified in accordance with the requirements of Section 260553 – Identification for Electrical Systems.

B. Cover plates for all junction and pull boxes and wireways 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 and a wireway 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 260519 – Low-Voltage Electrical Power Conductors & Cables

C. Section 260533.13 – Conduit for Electrical Systems

D. Section 260533.16 – Boxes for Electrical Systems

E. Section 260573 – Protective Device Coordination Study and Arc Flash Risk Assessment

F. Section 261216 – Dry-Type, Medium-Voltage Transformers

G. Section 261219 – Pad-Mounted, Liquid-Filled, Medium-Voltage Transformers

H. Section 262416 – Panelboards

I. Section 262816.13 – Enclosed Circuit Breakers

J. Section 262816.16 – Enclosed Switches

K. Section 262913.13 – Across-the-Line Motor Controllers

L. Section 337110 – Medium-Voltage Outdoor Sectionalizing Cabinets

M. Section 337149 - Medium-Voltage Wiring

N. Section 337710 – Medium-Voltage Pad-Mounted Switchgear

1.4 SUBMITTALS

A. Submit electrical identification data as follows:

1. Nameplate type product data
2. Nameplate engraving schedule
3. Conduit marker product data
4. Wire and cable identification label product data

5. Medium-voltage power circuit identification tags
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.

B. Nameplates that will be located outdoors must be constructed from material that is weatherproof and resistant to ultraviolet light.

C. Nameplate engraving shall be as follows:

1. Lettering font shall be Gothic.
2. Nameplate character sizes shall be:
    a. 3/4-inch high – Medium-voltage outdoor sectionalizing cabinets and medium-voltage pad-mounted switchgear.
    b. 1/2-inch high – Transformers, switchboards, panelboards rated ≥ 400A and enclosed circuit breakers
    c. 3/8-inch high – Panelboards rated < 400A, branch circuit breakers in panelboards rated ≥ 400A, enclosed switches, across-the-line motor controllers, dimensioned junction and pull boxes and wireways.
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: SWGR SW-7
    b. Voltage and phases such as: 12.47kV-3PH-3W
    c. Designation of source equipment, such as: FED FROM SWGR MCSG
    d. Location of source equipment, such as: WAREHOUSE
6. Engraving designations shall be approved by the Designer by means of the shop drawing submittal process.

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 .....1/2” character height
2. Conduits 1-1/2” and larger .....1” character height

B. Markers shall identify voltage and functional use of the conduit, such as “208 VOLT 3 PHASE”, “120/208 VOLT”, “120 VOLT”, “CONTROL”, 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 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., “#2 CU”
3. Cable type; e.g., “MV-105, 133% EPR”
4. Source and destination; e.g., “SW-8 to XFMR T-16”
5. Feeder number designation as indicated on the Drawings; e.g., “FDR T16”

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. For incident energy values less than or equal to 40 cal/cm^2, label shall indicate “WARNING” using black lettering on an orange background. The remainder of the label shall have black characters on a white background.

C. For incident energy values greater than 40 cal/cm^2, label shall indicate “DANGER” using white lettering on a red background. The remainder of the label shall have black characters on a white background.

D. Labels installed outdoors shall be weatherproof and resistant to ultraviolet light.

E. 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. Maximum available fault current (This is the value calculated using the ANSI fault current evaluation method and listed in the ANSI short circuit evaluation table that is used for establishing the minimum SCCR of the equipment.)

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.

F. 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 ELECTRICAL COLOR CODE TAPE

A. Each circuit conductor and power cable shall be color coded with colored insulation/cable jacket. Where colored insulation/cable jacket is not available for a particular conductor size, color code the conductor/power cable with 3M No. 35 tape, 3/4" width.

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.

B. All nameplates, labels, markers and panelboard circuit directories must be installed prior to turning operation of the equipment over to the Owner.

3.2 NAMEPLATES

A. Nameplates shall be provided for each dimensioned junction and pull box, wireway, transformer, panelboard, enclosed circuit breaker, enclosed switch and for each enclosed circuit breaker, and across-the-line motor controller.

B. Nameplates shall be secured with an approved adhesive such as Goodyear "Pliobond" glue or stainless-steel machine screws in tapped holes (in NEMA 1 rated enclosures only). 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 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 in medium-voltage sectionalizing cabinets, medium-voltage pad-mounted switchgear, medium-voltage transformers, cable vaults, underground handholes and manholes using one-piece self-locking nylon cable ties. Cut off excess cable tie. Do no 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) 30A and larger, enclosed circuit breakers, diesel-engine-driven generator output circuit breaker, resistive load bank,

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 CABLE/CONDUCTOR COLOR CODING

A. Each power circuit conductor and power cable shall be color coded with colored insulation. Identify conductors/cables not available color coded from the manufacturer by field application of electrical color code tape. Per NEC 200.6(A), neutral conductors size #6 AWG and smaller must have white insulation. It is not permissible to mark conductors of this size with white tape.

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

120/240V 1 Phase	120/208V 3 Phase
Phase A Black	Phase A Black
Phase B Red	Phase B Red
Neutral White	Phase C Blue
Equipment Ground Green	Neutral White
	Equipment Ground Green

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

12.47kV 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

D. 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 AND OUTLET BOX AND WIREWAY IDENTIFICATION

A. The covers 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 and wireways 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.

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 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 Designer 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 261216 – Dry-Type, Medium-Voltage Transformers

D. Section 261219 – Pad-Mounted, Liquid-Filled, Medium-Voltage Transformers

E. Section 262416 – Panelboards

F. Section 262813 – Fuses

G. Section 262816.13 – Enclosed Circuit Breakers

H. Section 262816.16 – Enclosed Switches

I. Section 262913.13 – Across-the-Line Motor Controllers

J. Section 337110 – Medium-Voltage Outdoor Sectionalizing Cabinets

K. Section 337710 – Medium-Voltage Pad-Mounted Switchgear

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 (2023 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 USB thumb drive 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 the USB thumb drive to include all models, data, single lines, etc.

D. General report requirements:

1. Include all facility power distribution system equipment located at the Bellefontaine Habilitation Center campus, both indoor and outdoor equipment, including but not limited to the equipment shown on Project Drawings E-601, E-602, E-603 and E-604.

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 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. Terminate protective device characteristics or operating band to reflect actual symmetrical and asymmetrical fault currents sensed by device.

   c. Prepare study with network analyzer, computer, or by written calculations. Include complete fault calculations as specified for each proposed and ultimate source combination.

   d. 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 Missouri 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 panelboards per Section 262416 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., 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. The scope of the protective device coordination study and arc flash risk assessment is to include an update to the campus wide SKM Study completed by Vincent Kunderman, P.E. on 9/19/2018 that incorporates all changes to electrical equipment throughout the facility that have occurred since that time, including but not limited to, the changes shown on the Drawings for this project. The native SKM files from the Vincent Kunderman, P.E. study will be provided to the study engineer for this project to use as the base model for the new study.

B. Examine submittals for new protective devices furnished on this project 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.

C. 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.

D. 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

E. 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 obtained from Ameren Missouri by inquiring at:

Ameren Missouri Construction Services
866-992-6619
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 (existing 1270kW diesel-engine-driven generator next to 12.47kV main campus switchgear) 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 the following new equipment:

1. Circuit breaker panelboard under Section 262416 - Panelboards
2. Enclosed circuit breaker under Section 262816.13 – Enclosed Circuit Breakers

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 Designer, 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 Bellefontaine Habilitation Center campus, both indoor and outdoor equipment, including but not limited to the equipment shown on Project Drawings E-601, E-602, E-603 and E-604.

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, main campus switchgear 48VDC battery system 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 from the manufacturer of the new panelboards provided on this project, to set overcurrent protective devices within the new 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 equipment located at the Bellefontaine Habilitation Center campus, both indoor and outdoor equipment, including but not limited to the equipment shown on Project Drawings E-601, E-602, E-603 and E-604.

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 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 as required by National Electrical Code (NEC) and/or NFPA 70E requirements for all facility power distribution system equipment located at the Bellefontaine Habilitation Center campus, both indoor and outdoor equipment, including but not limited to the equipment shown on Project Drawings E-601, E-602, E-603 and E-604.

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.

4. Provide a label for each of the two main breakers in the preferred-reserve 12.47kV main campus switchgear that indicates the maximum available fault current and the date the fault current calculations were performed for compliance with NEC Article 110.24(A).

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 will 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

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 and 600-volt multi-conductor control 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

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, including NEC 230.46 compliant splice connectors
3. 600-volt in-line splice insulating materials

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.

5. In-line service entrance conductor splices shall only be made where specifically indicated on the Drawings or where pre-approved by the Designer.

   a. Splice connectors must be UL Listed and marked "suitable for use on the line side of the service equipment" or equivalent in accordance with NEC 230.46.

   b. NSI Industries Polaris Series ISRH, IT or ITH or approved equal by 3M, Burndy, 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. 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.

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 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 a NEC sized junction box or wireway meeting the requirements of Section 260533.16 – Boxes for Electrical Systems.

B. Split-bolt connectors are not approved for any use other than connection of two (2) equipment grounding conductors or bonding jumpers in accordance with Specification Section 260526 – Grounding and Bonding 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.

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.

2. 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.

3. 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 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 261216 – DRY-TYPE, MEDIUM-VOLTAGE TRANSFORMERS

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. The Contractor shall furnish and install all dry-type medium-voltage secondary unit substation transformers 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 260573 – Protective Device Coordination Study and Arc Flash Risk Assessment

H. Section 337149 – Medium-Voltage Wiring

1.4 STANDARDS

A. Substation transformers shall be designed, manufactured and tested the latest applicable standards of NEMA and ANSI. ANSI C57.

B. Transformer losses shall conform to NEMA TP1 requirements.

C. Transformer losses shall be tested in accordance with NEMA TP2 procedures.

1.5 SUBMITTALS

A. Manufacturer’s product data sheets and shop drawings shall be submitted for each transformer:

1. Master drawing index
2. Front view elevation and weight
3. Plan view
4. Schematic diagrams
5. Nameplate diagram
6. Component list
7. Conduit entry/exit locations
8. Ratings including:

a. kVA
b. Primary and secondary voltage
c. Taps
d. Primary and secondary continuous current
e. Basic Impulse Level
f. Impedance
g. Insulation class and temperature rise4

9. Cable terminal sizes
10. Product data sheets
11. Wiring diagrams
12. Certified production test reports
13. Installation information
14. Seismic certification
15. Equipment operation and maintenance manuals meeting the requirements of Section 017823 – Operation and Maintenance Data shall be provided with each assembly shipped and shall include instruction leaflets, instruction bulletins and renewal parts lists where applicable, for the complete assembly and each major component.
16. Field test report
17. Final as-built drawings and information for items listed in Article 1.5 that incorporate all changes made during the manufacturing process.

1.6 QUALIFICATIONS

A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

B. The manufacturer of the equipment specified herein shall be ISO 9001 or 9002 certified.

C. The manufacturer of the specified 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.

1.7 REGULATORY REQUIREMENTS

A. Equipment shall be UL listed and labeled.

1.8 WARRANTY

A. The manufacturer’s factory warranty shall be a minimum of twelve (12) months after energization or eighteen (18) months after delivery, whichever comes first.

1.9 DELIVERY, STORAGE AND HANDLING

A. Equipment shall be handled and stored in accordance with the manufacturer’s instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

PART 2 - PRODUCTS

2.1 DESCRIPTION

A. Dry-type, medium-voltage transformers shall be dry type, self-cooled, metal enclosed, indoor, secondary unit substation type as indicated on the Drawings. Voltages, continuously rated capacities, number of phases and wires, and connections shall be as specified herein and as indicated on the Drawings. Unless otherwise specified, all transformers shall be designed to operate at 60 hertz.

B. Ratings:

1. kVA Rating: 150kVA AA, 3-phase, 60 Hz
2. Impedance: 4.5% with +/- 7.5% ANSI standard tolerance
3. HV: 12.47kV Delta, bottom entry on right-hand side
4. HV BIL: 60kV
5. HV De-energized Taps: +2 & -2 @ 2.5% of full capacity
6. LV: 208Y/120V, top entry on left-hand side
7. LV BIL: 10kV
8. Altitude: 3,300 feet maximum

C. Transformers shall be of the two-winding type. Three-phase medium-voltage transformers shall have a delta connected primary winding and a wye connected secondary winding.

D. Transformers shall be cooled by natural air convection (AA). Transformers that utilize fans or other forced cooling methods to achieve nameplate full load rating are not acceptable.

E. The electrical insulation system shall utilize Class H material in a fully rated 220° C system. Transformer design temperature rise shall be based on a 30° C average ambient over a 24-hour period with a maximum of 40° C. Solid insulation in the transformer shall consist of inorganic materials such as porcelain, glass fiber, electrical grade glass polyester, electrical grade epoxy, or Nomex. All insulating materials must be rated for continuous 220° C duty. The insulation between the high- and low-voltage coils shall be more than sufficient for the voltage stress without the need of a varnish.

F. The transformer shall be designed for a temperature rise of 150° C at full rated load and shall be capable of operating at 0% above base nameplate kVA capacity continuously without any loss of life.

G. The transformer shall be designed to meet the sound level standards for dry-type transformers as defined in NEMA TR1. The measurement procedure shall be as specified in ANSI C57.12.90.

Self-Cooled, Full Load kVA Rating	Average Sound Level, Decibels
51 to 150 kVA	50 dB

H. Transformers shall be designed and built in accordance with the latest revision of all applicable NEMA, ANSI, and IEEE Standards and shall be UL listed and labeled.

I. The transformer shall be of fire-resistant, air-insulated, ventilated dry-type construction, and cooled by the natural circulation of air through the windings.

J. High-voltage and low-voltage windings shall be copper or aluminum. Insulation between layers of the windings shall be by Insuldur paper or equal.

K. The high- and low-voltage coil assembly shall be Vacuum Pressure Impregnated (VPI) polyester.

L. The high- and low-voltage coil assembly shall be preheated to evaporate any moisture, then placed into a vacuum pressure tank. The air in the tank shall be evacuated; and at extremely low absolute pressure, all air bubbles are to be drawn out of the insulating materials. The resin shall be introduced to a level that submerges all parts while the vacuum is maintained. Then the vacuum shall be released and pressure applied, after which the coil shall be removed and placed in an oven for several hours in order for the resin to catalyze into a composite mass, completely sealing and binding the winding.

M. Transformers shall be low loss type with minimum efficiencies per DOE 2016. Minimum efficiency when operated at 50% of full load capacity shall be 98.51.

N. Transformers shall be designed for continuous operation at rated kVA, for 24 hours a day, 365 days a year operation, with normal life expectancy as defined in ANSI C57.96.

O. The completed core and coil shall be bolted to the base of the enclosure but isolated therefrom by means of rubber, vibration-absorbing mounts. There shall be no metal-to-metal contact between the core and coil and the enclosure. Rubber vibration isolating pads shall be installed by the manufacturer between the core and coil and the enclosure. The core shall then be visibly grounded to the ground bus or ground pad inside the transformer enclosure by means of a flexible grounding conductor sized in accordance with applicable NEMA, ANSI, and NEC Standards, or as indicated on the Drawings.

P. The transformer shall be supplied in a knockdown case design, for ease in fitting through limited openings, and shall be of heavy gauge sheet steel construction, equipped with removable panels for access to the core and coils. Front and rear panels shall incorporate louvered ventilating grills. Enclosure rating shall be NEMA Type 1, indoor ventilated.

Q. Maximum allowable dimensions for 150kVA, 12.47kVΔ-208Y/120V, 3-phase transformer, including the air terminal cabinet, if one is required, shall be: 96”Hx86”Wx54”D.

R. Transformer shall be designed for high voltage cable entry by means of a conduit entry in the bottom right-hand side of the enclosure and shall have adequate wiring space and clearance for skirted stress cone cable terminations.

S. Transformer shall be designed for secondary voltage conductor entry by means of conduit connections to the top left-hand side of the enclosure and shall have adequate wiring space and clearance for two-hole, rectangular tongue, long-barrel compression type connectors.

2.2 ACCESSORIES

A. Transformers shall include:

1. Laser engraved stainless steel or aluminum diagram instruction plate
2. Provisions for lifting and jacking
3. Removable center panel for access to high-voltage strap-type connector taps for de-energized tap changing
4. Two ground pads with continuous 0.25” x 2.00” copper ground bus

2.3 FINISH

A. The transformer enclosure paint finish shall be applied using an electrostatically deposited dry powder system to a minimum of three (3) mils average thickness. Units shall be painted ANSI 61 for indoor service and shall match the primary and secondary equipment.

2.4 AIR TERMINAL COMPARTMENT

A. The transformer unit shall include a high voltage or low voltage cable air terminal compartment, if necessary to accommodate the primary and secondary cable/conductor/conduit connections indicated in Article 2.1 above. The air terminal compartment, if provided, shall be the same height and depth as the transformer enclosure and shall be a maximum of 20" wide and shall be provided on either the HV or LV side of the transformer but not both.

B. Paint color/finish shall be the same as provided on the transformer enclosure.

2.5 FACTORY TESTING

A. The following standard factory tests shall be performed on all equipment provided under this section. All tests shall be in accordance with the latest version of ANSI and NEMA standards.

1. Resistance measurements of all windings on the rated voltage connection of each unit and at the tap extremes of one unit only of a given rating on this project.
2. Ratio tests on the rated voltage connection and on all tap connections.
3. Polarity and phase-relation tests on the rated voltage connection.
4. No-load loss at rated voltage on the rated voltage connection.
5. Exciting current at rated voltage on the rated voltage connection.
6. Impedance and load loss at rated current on the rated voltage connection of each unit and on the tap extremes of one unit only of a given rating on this project.
7. Applied voltage potential test.
8. Induced voltage potential test.
9. The transformer manufacturer shall perform additional 100% quality control impulse test on the primary windings of each unit.

B. The transformer manufacturer shall provide three (3) certified copies of factory test reports.

2.6 APPROVED MANUFACTURERS

A. Transformers shall be manufactured by:

1. Square D Class 7420 (Basis of Design)
2. Eaton
3. ABB - Hitachi
4. Olsun
5. Hammond

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install transformers at locations indicated on the Drawings, including all necessary mounting and supporting materials.

B. Follow the transformer manufacturer's written instructions for installation and seismic restraint of the transformer.

C. Floor mount on concrete housekeeping pad as indicated on the Drawings. If the provided transformer is more than 4'-0" in depth, extend existing concrete housekeeping pad in accordance with Section 260500 – Common Work Results for Electrical.

D. Locate and orient the transformer with proper clearances from other equipment and building walls and doors to obtain good accessibility for operation and maintenance.

E. Provide all necessary openings in transformer enclosure, and air terminal cabinet if one is provided, for conduit access.

F. 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. Koppers' Organic Zinc

G. Ground all enclosures and neutral bushings in accordance with the National Electrical Code, Section 260526 - Grounding and Bonding for Electrical Systems and as indicated on the Drawings.

H. Electrical conduit terminations to the top of the transformer enclosure shall be via liquidtight flexible metal conduit connections, approximately 24 inches long, to prevent transmission of noise and vibration.

I. All conductor connections shall be oxide inhibited.

J. Measure primary and secondary voltages and make appropriate tap adjustments.

K. Each transformer shall have a laminated plastic nameplate meeting the requirements of Section 260553 – Identification for Electrical Systems affixed to the front exterior surface of the unit engraved with the transformer designation as indicated on the Drawings.

3.2 FIELD TESTING

A. Measure primary and secondary voltages after proper adjustment of tap settings.

B. Megger primary and secondary windings.

C. Submit signed and dated field test report indicating results of all field testing and make, model and calibration date of all test equipment used.

END OF SECTION 261216

SECTION 261219 – PAD-MOUNTED, LIQUID-FILLED, MEDIUM-VOLTAGE TRANSFORMERS

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. The Contractor shall furnish and install a three-phase, pad-mounted, less flammable liquid-filled, medium-voltage transformer 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 260553 – Identification for Electrical Systems

F. Section 260573 – Protective Device Coordination Study and Arc Flash Risk Assessment

G. Section 337149 – Medium-Voltage Wiring

1.4 REFERENCES

A. All equipment shall conform to the latest revision of all applicable standards, including but not limited to:

1. ANSI C2 – National Electrical Safety Code (NESC)
2. ANSI C37.47 – Specifications for Distribution Fuse Disconnecting Switches, Fuse Supports, and Current-Limiting Fuses
3. ANSI C57.12.26 – Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers with Separable Insulated High-Voltage Connectors: High Voltage, 34,500GRDY/19,920 Volts and Below; 2,500 kVA and Smaller
4. ANSI C57.12.28 – Switchgear and Transformers, Pad-Mounted Equipment - Enclosure Integrity
5. ANSI/IEEE 386 – Separable Insulated Connector Systems for Power Distribution Systems Above 600V
6. ASTM D 877 – Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes
7. ASTM 92 – Standard Test Method for Flash and Fire Points
8. IEEE C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers

9. IEEE C57.12.90 – Standard Test Code for Liquid-Immersed Distribution Power, and Regulating Transformers and Guide for Short-Circuit Testing of Distribution and Power Transformers
10. NEMA LA 1 – Surge Arresters
11. NEMA TR1 – Transformers, Regulators, and Reactors
12. NFPA 70 – National Electrical Code (NEC)
13. OSHA – Federal Occupational Safety and Health Standards
14. UL 486A - 486B – Wire Connectors
15. UL 486E – Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors

1.5 SUBMITTALS

A. Provide certified test reports indicating compliance with specified performance requirements.

B. Submit manufacturer's product information showing equipment/material proposed. Submit sufficient information to determine compliance with Drawings and Specifications. Product data shall include, but shall not be limited to, the following:

1. Rated kVA
2. Frequency
3. Primary and secondary voltages
4. Tap arrangement
5. Polarity
6. Primary and secondary continuous current (FLA)
7. Basic impulse level of primary and secondary windings
8. Impedance
9. No-load and full-load losses in watts
10. Insulation class
11. Percent impedance at 75˚C
12. Hot-spot and average temperature rise above 40˚C ambient temperature
13. Sound level at full load (dBA)
14. Standard published data

C. Submit complete shop drawings as required to determine acceptability. Drawings shall include all accessories specified and complete Bill of Material listing items by quantity, description and manufacturer’s catalog number. Shop drawings shall include, but shall not be limited to, the following:

1. Drawings index
2. Dimension and weight loadings for transformer installation
3. Layouts
4. Mounting and supports
5. Accessory locations
6. Transformer connections to electrical equipment
7. Front view elevation
8. Nameplate location
9. Nameplate diagram
10. Component list

11. Conduit entry/exit locations
12. Cable terminal sizes
13. Cable connection details
14. Cable support details
15. Low voltage bushings and spade terminals
16. High voltage load-break elbow connectors

D. Wiring Diagrams and Schematic Diagrams: Submit with shop drawings wiring, protection and control diagrams for pad-mounted distribution transformers. Clearly differentiate between portions of wiring that are manufacturer installed and portions to be field installed.

E. Installation and Bolt Setting Diagrams: Submit with shop drawings complete installation instructions, recommended pad dimensions, and bolt setting information for items of equipment.

F. Coordination and Site Service Data: Provide with shop drawings erection drawings and complete installation instructions for shipment, unpacking, installation, erection, adjustment, commissioning, and operation of equipment.

G. Detailed specification of construction and fabrication

H. Manufacturer's product data sheets for 200-ampere load-break bushing insert modules, surge arresters, insulated protective caps and insulated standoff parking bushings.

I. Submit Operation and Maintenance Manuals

1. Submit operating instructions including instructions for fuse replacement and switch adjustment.
2. Manuals shall include items listed below and other information recommended by manufacturer:

    a. Catalog information of unit installed
    b. Capacity and installation details
    c. Wiring diagrams of electrical components
    d. Complete list of parts with reordering numbers
    e. Operating pressures and temperatures
    f. Electrical characteristics of components
    g. Recommended spare parts list
    h. Complete set of the "for record" revision of the shop drawings

1.6 EXTRA MATERIALS

A. Provide three (3) spare bayonet expulsion fuses.

B. Provide one (1) 12-ounce to 16-ounce minimum, aerosol can each of red-oxide primer and Munsell 7.0GY3.29/1.5 paint for touching up scratches in the transformer enclosure paint finish.

C. Provide three (3) spare elbow type surge arresters.

1.7 WARRANTIES

A. Manufacturer of pad-mounted, liquid-filled, medium-voltage transformers shall warrant that equipment will be free from defects in material and workmanship for a period of twelve (12) months from energization and acceptance or eighteen (18) months from date of shipment, whichever comes first.

PART 2 - PRODUCTS

2.1 GENERAL

A. Transformers shall be three-phase, 60 Hz, liquid-filled, self-cooled, pad-mounted, compartmental type distribution transformer, with separable insulated high voltage connectors.

B. All equipment must be new and shall be UL listed and labeled. Re-manufactured equipment is not acceptable.

2.2 RATINGS

A. Transformers shall have the following ratings and characteristics:

1. Location: Outdoor rated for pad-mount installation
2. kVA Rating: 150 kVA
3. Phase: 3
4. Frequency: 60 hertz
5. Windings: 2
6. Primary Voltage (HV) Windings:

    a. Phase Voltage: 12,470 Volts line-to-line
    b. Taps: 2 ± 2.5% full capacity
    c. Winding Connection: Delta
    d. Basic Impulse Level (BIL): 95 kV
    e. Primary Termination: 15 kV dead front with load break elbow connectors
    f. Winding Conductors: Copper or Aluminum

7. Secondary Voltage (LV) Windings:

    a. Phase Voltage: 208 Volts line-to-line
    b. Winding Connection: Wye
    c. Basic Impulse Level (BIL): 30 kV
    d. Phase-to-Neutral Voltage: 120 Volts
    e. Neutral (X0) Insulation Class: 600 Volts
    f. Secondary Termination: 1.2 kV bushing with 4-hole spade
    g. Winding Conductors: Copper or Aluminum

8. Winding Temperature Rise: 65˚C
9. Winding Insulation Temperature Rating: 120 ˚C
10. Impedance: In accordance with all applicable standards

B. Efficiency: Transformer efficiency shall meet all DOE 2016, 10 CFR Part 431 requirements.

2.3 CONSTRUCTION FEATURES

A. Transformers shall be pad-mount construction in accordance with ANSI Standard C57.12.26, latest revision.

B. Transformers shall be compartment type, liquid immersed, self-cooled, with bolt-on covers.

1. Each transformer shall have high and low voltage compartments assembled side by side as an integral unit with no live parts accessible without opening the compartment doors.
2. The high voltage compartment shall be located on the left.
3. High voltage compartment shall be separated from the low voltage compartment by a metal barrier.
4. No bolts, screws or other fastening devices shall be externally removable.
5. There shall be no openings where sticks, rods or other devices could be inserted and contact live parts.
6. Compartments shall limit water entry.
7. Doors:

    a. The secondary compartment door shall include provisions for a padlock, which must be removed to access a penta-head bolt to allow opening the door.
    b. The primary compartment door shall be separate and shall interlock with the secondary compartment door in such a manner that the secondary compartment door must be opened first, before the primary compartment door can be opened.
    c. The primary compartment door shall also be secured with penta-head bolts in addition to the bolts securing the secondary compartment door.
    d. The hinge assemblies shall be made of corrosion resistant material. Stainless steel hinge pins shall be provided.

C. Transformer Enclosure:

1. Transformers shall be furnished with jacking provisions and lugs for lifting.
2. Enclosure and base shall be constructed for sliding and rolling.
3. Enclosure shall be tamperproof.
4. Enclosure design and construction shall prevent accumulation and pooling of water.

D. Paint:

1. Paint shall be suitable for outdoor equipment installation.
2. Munsell green #7.0GY3.29/1.5
3. Minimum thickness shall be 2.5 mil.

E. Wind coils with copper or aluminum conductors. Core and coil assembly shall be wound core type, using high grade, grain-oriented silicon steel laminations carefully annealed after fabrication to restore high magnetic permeability. Magnetic flux is to be kept well below saturation point. The core shall be constructed to reduce eddy current losses at fundamental and harmonic frequencies.

F. Windings: 2-winding type, designed for operation with high-voltage windings delta connected to a 3-phase, 3-wire, 60 Hz, grounded neutral distribution system.

1. Primary windings shall be constructed with copper or aluminum conductors. Primary windings shall be transposed for reduced losses at fundamental (60 Hz) and harmonic frequencies, if advisable per the manufacturer. Primary conductors shall be designed to withstand high 3rd, 9th, and 15th order harmonic circulating currents.
2. Secondary windings shall be constructed with copper or aluminum conductors. Secondary windings shall be transposed for reduced losses at fundamental (60 Hz) and harmonic frequencies, if advisable per the manufacturer. Use smaller paralleled conductors instead of one larger cross-section single conductor or a single thin tape type of conductor. Individual conductors shall be insulated.

G. Neutral conductor shall be sized to handle up to 100% of the rated phase current continuously.

H. Transformer shall have a maximum average winding temperature rise of 65ºC over an average ambient temperature of 30ºC over 24 hours with a maximum ambient temperature not to exceed 40ºC.

I. Winding insulation shall have a minimum rating of 120ºC.

2.4 FULL CAPACITY PRIMARYVOLTAGE TAPS

A. Provide five (5) nominal 2.5% taps, two above and two below rated primary voltage, with externally operable tap changer for de-energized use, with position indicator. The tap changer shall be clearly labeled to reflect that the transformer must be de-energized before operating the tap changer as required by ANSI C57.12.26.

2.5 INSULATING LIQUID

A. Transformer dielectric insulating liquid shall be UL Classified, Factory Mutual Approved, less-flammable fluid with a flash point (per ASTM D92) of not less than 300ºC and a fire point (per ASTM D92) of not less than 340ºC. Insulating liquid shall be Cargill Envirotemp FR-3 or Engineer approved equal.

B. A liquid level indicator shall be provided on each transformer. It shall be located inside the low-voltage compartment.

C. A drain valve and sampling device shall be installed in the secondary compartment of each transformer.

D. A pressure relief valve shall be provided on each transformer. Qualitrol Series 210 pressure relief valve or approved equal for NEC 450.23 code application. Volume of valve must meet all applicable codes.

E. A temperature indicator shall be provided on each transformer.

F. A one-inch upper fill plug shall be provided on each transformer.

G. Transformers shall be vacuum-filled with the appropriate fluid as indicated above. The process shall be of sufficient vacuum and duration to insure that the core and coil assembly is free of moisture prior to filling the tank.

2.6 HIGH VOLTAGE TERMINATIONS

A. High voltage terminals: Arranged for radial feed. Transformer shall have three (3) 15 kV primary bushings, for a delta connection of 12,470 V, dead front design with load break elbows with a 95 kV BIL rating. Bushings shall be 200-ampere universal wells. Bushings and wells shall be externally clamped and front removable.

B. Primary compartment shall be separated from the secondary compartment by a permanent metal barrier.

C. Provide double 200-ampere load-break bushing insert module, with an insulated protective cap, on each primary bushing to allow for installation of load break elbow type surge arresters. All primary bushings shall be sufficiently spaced to accommodate the bushing insert modules and installation of the elbow type surge arresters. The insulated protective caps shall insulate, shield and completely water seal the energized bushing insert modules. Bushing insert modules and insulated protective caps shall be manufactured by Eaton-Cooper, Elastimold, Raychem, or 3M.

D. Each bushing well shall be provided with a cable elbow terminator parking stand welded to the tank wall adjacent to the bushing to accommodate accessory standoff bushing for elbow storage during maintenance activities.

E. All wiring connections shall be suitable for copper or aluminum conductors.

2.7 SWITCHING

A. Each transformer shall be provided with a 300A, in-tank, under-oil, two- position, gang-operated, load-break, hook-stick operable radial-feed switch on the primary to allow the transformer to be turned on and off.

B. The two-position radial switch shall use a manually charged over-toggle storing spring assembly that is independent of the operator speed. The spring-loaded activating mechanism shall ensure quick load-break and load-make operation for de-energizing/energizing the transformer.

C. The switch must be rated to interrupt the full load current of the transformer.

D. The switch must be located in the primary compartment and shall be provided with a nameplate to indicate the function and proper means of operation.

E. The switch shall be provided with a hot-stick operated handle.

2.8 LOW VOLTAGE TERMINATIONS

A. Low voltage compartment: The secondary voltage shall be 208Y/120 Volt, 3-phase, 4-wire, wye-connected. Secondary bushings shall have a 30 kV BIL rating and shall be molded epoxy with tinned copper blade type spade, each having four (4) 9/16" holes on 1¾" centers arranged for vertical take-off for conductor connections by means of bolted two-hole, rectangular tongue, compression type lugs. Four bushings shall be supplied for wye connections. The secondary voltage neutral shall be an insulated bushing grounded to the transformer tank by a removable grounding strap.

B. Arrange low voltage bushings for cable entry from below grade.

C. All wiring connections shall be suitable for copper or aluminum termination lugs.

2.9 SURGE ARRESTERS

A. Each transformer shall include three (3) 9 kV duty cycle voltage rated, 7.65 MCOV, load break elbow, plug in, MOV type surge arresters, with braided copper ground conductor, in the primary compartment, one for each primary phase.

B. Surge arresters shall be distribution class and shall comply with NEMA Standard LA 1.

C. Surge arresters shall be Eaton-Cooper Type M.O.V.E or approved equal by Elastimold or Hubbell Power Systems.

D. Transformer must be provided with double 200-ampere load-break bushing insert modules, as specified herein, for installation of surge arresters.

E. Three (3) spare surge arresters shall be furnished with each transformer and provided to the Construction Representative.

2.10 SOUND LEVEL

A. Noise level of transformers shall be per IEEE/ANSI/NEMA standards and shall not exceed the levels given by the latest revision of NEMA TR1.

2.11 OVERCURRENT PROTECTION

A. Fusing shall consist of liquid-immersed, bayonet expulsion fuses and in-tank, current-limiting fuses. Current limiting fuses shall be provided in series with the bayonet expulsion fuses to provide full range protection for faults up to 10,000 RMS symmetrical amperes.

B. Fusing combination shall provide full range protection for low and high current faults and transformer overload. The let-through current of the in-tank current-limiting fuses cannot exceed the interrupting rating of the switch specified.

C. Bayonet fuses shall be removable with a hot stick and shall have a drip shield permanently welded under the fuses to protect the bushings and cables against hot oil spillage during a bayonet fuse change-out.

D. Three spare bayonet fuses shall be supplied with each transformer. (This totals six bayonet fuses per transformer.)

2.12 GROUNDING

A. Three (3) enclosure grounding connections, each with two (2) 1/2”-13 UNC tapped holes, shall be provided on each transformer.

1. One shall be located inside the primary compartment
2. One shall be located inside the secondary compartment
3. One shall be located outside of the enclosure on the tank

B. A copper connection strap from the secondary neutral (X0 bushing) to ground shall also be supplied.

2.13 ACCESSORIES

A. Each transformer shall be provided with the following accessories:

1. One-inch drain valve with sampling device located in the low-voltage compartment
2. Dial type thermometer located in the low-voltage compartment
3. Liquid level indicator located in the low-voltage compartment
4. Pressure vacuum gauge located in the low-voltage compartment
5. Automatic pressure relief device, self-sealing with indicator
6. Standoff parking bushings

   a. Furnish three (3) portable, insulated, standoff parking bushings for each pad-mounted transformer for storage of a disengaged 200A load-break elbow inside the transformer primary terminal compartment.
   b. Insulated standoff parking bushings shall meet the full requirements of ANSI/IEEE Standard 386, "Separable, Insulated Connector Systems".
   c. Insulated standoff parking bushings shall be designed to be installed in the parking bracket located in the pad-mounted transformer primary cable termination compartment.
   d. A grounding lug shall be provided on each standoff parking bushing bracket for attachment of a grounding wire to ensure dead-front construction.
   e. Each 200A standoff parking bushing shall have a molded EPDM rubber body, stainless steel eyebolt with a brass pressure foot and stainless steel or cast aluminum base bracket. The EPDM rubber body shall be bolted to the base bracket using a galvanized steel hold-down ring.
   f. 200A, 15 kV Class insulated standoff parking bushings shall meet the following requirements:

      1) Standard Voltage Class: 15 kV
      2) Maximum Rating, Phase-to-Phase: 14.4 kV
      3) Maximum Rating, Phase-to-Ground: 8.3 kV
      4) AC, 60 Hz, 1 Minute Withstand: 34 kV
      5) DC, 15 Minute Withstand: 53 kV
      6) BIL and Full Wave Crest: 95 kV
      7) Minimum Corona Voltage Level: 11 kV
      8) Continuous and Load Break Current Rating: 200A
      9) 10 Cycle Momentary & Fault Close: 10 kA Symmetrical

   g. Insulated standoff parking bushings shall be manufactured by Eaton-Cooper, Elastimold, Raychem, or 3M.

2.14 NAMEPLATE

A. Laser engraved, stainless steel: In addition to the normal information, the following items shall be included on the nameplate of each unit.

1. kVA ratings
2. Primary voltage
3. Secondary voltage
4. Full load secondary current
5. BIL ratings

6. Temperature ratings
7. Primary and secondary voltages for each tap setting
8. Primary current rating for each tap setting
9. Date of manufacture
10. Name of manufacturer
11. Type of conductor in windings
12. Impedance expressed in percentage
13. Detailed circuit diagrams of primary switch configuration and switch ratings
14. Delta – wye diagram detailing the relationship of primary to secondary bushings
15. Statement "Transformer filled with less-flammable fluid"
16. Statement "Transformer filled with fluid containing no detectable PCB's at time of manufacture"
17. Total gallons of insulating liquid
18. Total weight of unit, expressed in pounds
19. Weight of unit without oil, expressed in pounds

B. The nameplate is to be located in the low voltage compartment and shall be readable with cables in place. Where the nameplate is mounted on a removable part, the manufacturer's name and transformer serial number shall be permanently affixed to a non-removable part.

2.15 LABELING

A. Standard labeling for pad-mounted electrical equipment.

B. Transformer shall have a blue "CONTAINS NO PCB'S" label placed inside of the secondary compartment door and another same label placed on the outside of the tank.

C. Transformer shall have a "Danger-High Voltage" label on the outside of the primary compartment door meeting all applicable standards.

2.16 FACTORY TESTING

A. Tests shall be made in accordance with the latest revision of ANSI Standard Test Code C57.12.90, where applicable.

B. Transformer shall pass the following routine factory electrical tests:

1. Polarity
2. No-Load Loss
3. Ratio
4. Demagnetization
5. Applied Voltage Test of high voltage
6. Applied Voltage Test of low voltage
7. Iron Loss and Exciting Current
8. Impedance
9. Load Loss

C. Transformer shall pass mechanical leak and pressure test on tank and cooler panels at 7 pounds per square inch without permanent distortion.

2.17 ACCEPTABLE MANUFACTURERS

A. Provide pad-mounted, liquid-filled, medium-voltage transformers manufactured by one of the following:

1. Eaton-Cooper
   Contact: Melissa Meywes, 636-279-9081
2. Hitachi-ABB
   Contact: Matt Scherbring, 314-610-6395
3. Square D by Schneider Electric
4. WEG
   Contact: Steve Shoemaker, 314-378-0859
5. Engineer approved equal

PART 3 - EXECUTION

3.1 INSTALLATION

A. Reference the transformer pad details on the Drawings.

B. Care shall be taken during lifting/moving so as not to damage or bump the transformer.

C. Locate transformers such that there is a minimum of 8'-0" clear area in front of the doors and a minimum of 5'-0" clearance from building walls in all directions.

D. Secure transformer to concrete pad at all four (4) corners using stainless steel anchor bolts in accordance with Specification Section 260529 – Hangers and Supports for Electrical Equipment.

E. Install transformers and accessories in accordance with manufacturer's written installation instructions.

F. Tighten electrical connectors and terminals in accordance with manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486.

G. Identify transformers in accordance with Section 260553 – Identification for Electrical Systems.

3.2 GROUNDING

A. Provide a 5/8" diameter by 10' long grounding rod meeting the requirements of Specification Section 260526 – Grounding and Bonding for Electrical Systems in the conduit access opening of the transformer pad in accordance with the transformer pad details on the Drawings.

B. Ground transformers and tighten connections to comply with tightening torques specified in UL 486.

C. Use exothermic welded grounding connections for wire-to-wire and wire-to-rod grounding connections. Make exothermic welds in accordance with the manufacturer's written recommendations. Welds that puff up to show convex surfaces are not acceptable. No mechanical connectors are required at exothermic weldments.

3.3 SURGE ARRESTERS

A. Connect the specified elbow type surge arresters to the specified double 200-ampere load-break bushing insert module on each phase and connect the ground cable of each arrester to the transformer ground pad in the primary compartment.

3.4 TESTING

A. Measure primary and secondary voltages and make appropriate tap adjustments.

3.5 ADJUSTING AND CLEANING

A. Upon completion of installation, inspect interiors and exteriors of accessible components. Remove paint splatters and other spots, dirt, and construction debris. Touch up scratches and mars of finish to match original finish using manufacturer supplied touch up paint.

END OF SECTION 261219

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

1.4 SUBMITTALS

A. Manufacturer's product data sheets and shop drawings shall be submitted for each circuit breaker panelboard, including the circuit breakers.

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. NEMA rating of panelboard enclosures.
3. The location of the circuit breakers, neutral and equipment ground busses and SPD (Alternate Bid No. 1).
4. 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) (Alternate Bid No. 1):

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 50 – Enclosures for Electrical Equipment, Non-Environmental Considerations

G. UL 67 – Standard for Panelboards

H. UL 489 – Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures

I. UL 1283 – Electromagnetic Interference Filters

J. 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. SPDs 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 circuit 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 steel or Type 304 stainless steel as indicated below and constructed in accordance with UL 50 requirements.

1. Physical Therapy Building Pool Mech/Elec Room

    a. Panelboard PT-MDP: NEMA Type 4X
    b. Panelboard PT-P2: NEMA Type 4X

2. Maintenance Building Main Electrical Room

    a. Panelboard MAINT-MDP: NEMA Type 12

D. All panelboard enclosures shall be surface mounted, fabricated from cold-rolled steel, thoroughly cleaned and then coated on all sides with rust-inhibiting primer and finished with the appropriate number of coats of ANSI-49 or ANSI-61 light gray baked-on enamel paint for Type 12 enclosures or unpainted Type 304 stainless steel for Type 4X enclosures. Each panelboard shall have a door with a locking handle requiring a milled key. Furnish two (2) keys for each panelboard and all panelboard locks shall be keyed alike. Panelboard enclosures shall be NEMA Type 12 or NEMA Type 4X as indicated above.

1. The maximum size of the enclosure for Panelboard PT-MDP shall be: 86"Hx38"Wx16"D
2. The maximum size of the enclosure for Panelboard PT-P2 shall be: 48"Hx24"Wx6"D

E. Side gutters and top and bottom gutters in all panelboard enclosures shall comply with the requirements of NEC 408.55 for the size of conductors to be terminated as indicated on the Drawings.

F. A framed circuit directory card with a clear plastic covering shall be provided on the inside of the inner door of each panelboard. 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 firmly over the circuit breakers.

H. All bus bars shall be silver-plated copper and shall be made all from the same material for Type 12 enclosed panelboards and tin-plated copper for Type 4X enclosed panelboards. 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 are not acceptable.

I. Copper bus bar conductors (phase and neutral) shall be fabricated from 1000A/in^2 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. 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(s) 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 <u>not</u> be electrically bonded together except for service entrance main panelboards that contain a main circuit breaker.

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 with electronic trip unit 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. All molded case, thermal magnetic main and branch circuit breakers with trip ratings $\geq$ 100A 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.

S. 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

T. Circuit breakers in panelboards shall have a minimum short-circuit interrupting capacity as indicated on the Drawings. Overall short circuit current rating of each panelboard shall be the value of the lowest rated circuit breaker installed within the panelboard.

U. 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.

V. Circuit breaker lugs shall be sized to accept the following size copper conductors:

Circuit Breaker Frame Size	Maximum Number and Size of Stranded Copper Conductors per Phase
15 to 20	(1) #10
25 to 35	(1) #6
40 to 60	(1) #4
70 to 100	(1) #1/0
110 to 225	(1) #250 KCM
300 to 400	(1) #600 KCM

W. Provide spare circuit breakers as indicated on the Drawings.

X. Single-pole circuit breakers in 208Y/120V panelboards having 15 or 20 ampere ratings shall be UL Listed as Switching Duty (SWD) rated.

Y. Circuit breakers protecting circuits supplying heating, ventilation or air conditioning equipment shall be UL Listed as HACR type.

Z. All wiring terminals for conductors leaving the panel shall be designed to be used with either copper or aluminum conductors.

AA. 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, left to right, top to bottom, front to back as viewed from the front of the panelboard.

BB. 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 blanking devices.

CC. 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.

DD. 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 rating.

EE. All panelboards shall be built in accordance with and to meet the requirements of the applicable sections of the National Electrical Code, NEMA Publication PBl, OSHA and applicable UL standards. All panelboards shall bear the Underwriters' Laboratories (UL) label of approval.

FF. The Main Distribution Panelboard (MDP) in the Maintenance and the Physical Therapy Buildings shall be:

1. Square D I-Line Series (Basis of Design)
2. ABB ReliaGear
3. Eaton Type PRL4X

GG. Panelboard P2 in the Physical Therapy Building Pool Mech/Elec Room shall be:

1. Square D Type NQ with Type QOB bolt-on circuit breakers (Basis of Design)
2. ABB ReliaGear RQ with Type THQB bolt-on branch circuit breakers
3. Eaton Type PRL1X with Type BAB bolt-on branch circuit breakers

HH. All panelboards and the enclosed circuit breaker, under Specification Section 262816.13 – Enclosed Circuit Breakers, shall be provided from the same manufacturer.

II. 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.

2.2 SURGE PROTECTIVE DEVICES (ALTERNATE BID NO. 1)

A. Provide integral surge protective device (SPD) factory installed on the following panelboards:

1. Panelboard MAINT-MDP in the Maintenance Building
2. Panelboard PT-MDP in the Physical Therapy Building

B. SPDs 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.

C. SPDs 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.

D. SPDs shall be UL 1449 labeled with 20kA I-nominal (In).

E. Suppression components shall be heavy duty, thermally protected, 50kA MOVs.

F. SPDs shall provide surge current paths for all modes of protection: L-N, L-G, N-G, and L-L for 208Y/120V, 3-phase, 4-wire systems.

G. SPDs shall be integral to the panelboard and shall be directly mounted to the panelboard bus bars. If inclusion of the integral bus mounted SPD in Panelboard PT-MDP causes the enclosure size to exceed the maximum dimensions indicated herein, then provide an SPD that meets these

requirements in a separate NEMA Type 4X stainless steel hinged door enclosure for field mounting immediately adjacent to the panelboard.

H. SPDs shall meet or exceed the following criteria:

1. Surge Current Capacity Ratings shall be 120kA per mode and 240kA per phase.
2. UL 1449 Listed Voltage Protection Ratings (VPRs) shall not exceed the following:

Nominal Voltage	L-N	L-G	N-G	L-L
208Y/120V, 60 Hz	700V	700V	600V	1000V

3. UL 1449 Listed Maximum Continuous Operating Voltage (MCOV):

Nominal Voltage	L-N	L-G	N-G	L-L
208Y/120V, 60 Hz	150V	150V	150V	300V

4. SPD shall have UL 1283 EMI/RFI filtering with active tracking up to 50dB from 10kHz to 100MHz.
5. 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.

6. *Environmental Conditions*:

   a. Operating temperature: -4°F to 122°F
   b. Relative humidity: 5 – 95%, non-condensing

I. *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.

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 manufacturer's 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. Panelboards furnished with external mounting tabs must be mounted to U-strut supports using the mounting tabs. Drilling mounting holes in the enclosure will void the UL Listing and the NEMA rating of the enclosure and will require the enclosure to be replaced.

E. 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

F. Panelboards < 5'-8" tall shall be installed with the top of the enclosure at 6'-0" above finished floor.

G. Panelboards ≥ 5'-8" tall shall be mounted on a 3-1/2" high concrete housekeeping pad per Section 260500 – Common Work Results for Electrical.

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, is/are not more than 6 feet, 7 inches above the floor, including the height of the housekeeping pad if one is installed, for compliance with NEC 404.8(A).

I. All rigid metal conduits which terminate at panelboards shall terminate 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 and bonded to the panelboard equipment ground bus in accordance with Section 260526 - Grounding and Bonding for Electrical Systems.

J. Adjust the interior such that the dead front fits securely over all of the circuit breakers and there are no gaps or spaces.

K. Provide blank filler plates for all unused circuit breaker spaces in all panelboards.

L. Provide NEMA Type 12 or 4X (to match the enclosure rating of the panelboard) gasketed hole seals for all unused conduit openings in the top, sides or back of all panelboard enclosures.

M. *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.

N. Perform insulation tests on each phase and verify low-resistance ground connections on equipment ground bus.

O. Reset SPD surge counter in each panelboard that is provided with an SPD to zero (0) (Alternate Bid No. 1).

3.2 IDENTIFICATION

A. Each panelboard shall have a laminated plastic nameplate, with engraved black characters on a white background, on the outside surface of the door engraved with the 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.

B. The directory card shall be printer generated to identify the load fed by each circuit for compliance with NEC 408-4 and then laminated with clear plastic to protect it from moisture.

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 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

C. Section 262816.16 – Enclosed Switches

D. Section 262913.13 – Across-the-Line Motor Controllers

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’s Representative, 10% spare fuses (minimum of 3) for each size and type of fuse, including control fuses, used on this project.

PART 2 - PRODUCTS

2.1 600-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 600 volts AC and up to 300 volts DC shall be 600VAC/300VDC, dual element, time delay, current limiting and shall have a minimum short circuit interrupting capacity of 300,000 RMS symmetrical amperes at 600VAC and 100,000 amperes at 300VDC, UL Class J for sizes up to 600 amperes.

C. Motor controllers shall be protected from short circuits by dual element, time delay, current limiting fuse to provide UL Type 2 protection. This level of protection shall allow no damage to the controller, under low and high level fault conditions.

D. Control circuit fuses (less than 5 amps) and associated fuse holders shall be as shown on the Drawings.

E. Fuses shall be as manufactured by the Eaton Bussmann or approved equal by Mersen or Littlefuse.

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, indicating fuse type, voltage and ampere rating, facing out such that the information 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 Listed and Labeled as service entrance equipment.

PART 2 - PRODUCTS

2.1 ENCLOSED CIRCUIT BREAKERS

A. The main circuit breaker for new electrical services shall have the following ratings:

1. Type: Molded case thermal magnetic

2. Frame size: 600A
3. Rating plug: 600A
4. Continuous current rating: 80%
5. Electronic trip unit: Long time, short time and instantaneous trip settings
6. Short circuit rating: ≥ 22kA
   Do not order 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.

B. Terminal lugs shall be sized for up to two (2) 500 kcmil conductors on the line and load side of the circuit breaker, 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.

C. Provide full rated isolated copper neutral bus within the circuit breaker enclosure with lugs for connection of two (2) 350 kcmil copper incoming and two (2) 350 kcmil copper outgoing neutral conductors.

D. Provide 200A rated copper equipment ground bus within the circuit breaker enclosure, bonded to the enclosure, with lugs for connection of two (2) 2/0 copper equipment grounding conductors, a 3/0 copper main bonding jumper and a 3/0 copper grounding electrode conductor.

E. Circuit breaker enclosures shall be NEMA Type 12 without knockouts and shall have a hinged cover.

F. 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.

G. All enclosures shall meet UL Standard 498 and shall be UL listed and labeled.

H. Circuit breaker enclosures shall be sized as required to provide enough air space around the circuit breaker for proper cooling in an outdoor ambient temperature of up to 104°F.

I. The minimum wire-bending space at terminals and the minimum gutter space within circuit breaker enclosures shall be as required per NEC 312.6 for (2) 500 KCM conductors per terminal on both the line and load side of the circuit breaker.

J. Circuit breaker enclosures shall be UL labeled as “suitable for service entrance”.

K. Provide weather and UV resistant label “MAIN SERVICE DISCONNECT” on outside front door of the circuit breaker enclosure.

L. 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.

M. 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.

N. Enclosed circuit breaker approved manufacturers are:

1. Square D PowerPact P with Micrologic 5.0 electronic trip unit (Basis of Design)

2. Approved equal by ABB
3. Approved equal by Eaton

O. All enclosed circuit breakers and panelboards, under Specification Section 262416 – Panelboards, shall be provided from the same manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide separately enclosed main circuit breaker at Maintenance Building service entrance location as indicated on the Drawings.

B. Mount indoor enclosed main circuit breaker to wall on U-channel supports, in accordance with Section 260529 – Hangers and Supports for Electrical Equipment, using the factory furnished external mounting tabs/flanges on the enclosure. Drilling mounting holes in the enclosure will void the UL Listing and the NEMA rating of the enclosure and will require the enclosure to be replaced.

C. All rigid metal conduits which terminate at enclosed circuit breakers shall terminate in zinc coated, insulated throat, grounding type, liquid tight rigid conduit hubs. Conduit hubs shall be provided in accordance with Section 260533.13 - Conduit for Electrical Systems and bonded to the enclosed circuit breaker enclosure equipment ground bus in accordance with Section 260526 - Grounding and Bonding for Electrical Systems.

D. Provide NEMA 12 gasketed hole seals for all unused conduit openings in the top, bottom, sides or back of the circuit breaker enclosure.

3.2 IDENTIFICATION

A. Mounted on the outside surface of each enclosure circuit breaker door shall be a three-layer engraved laminated plastic nameplate meeting the requirements of Section 260553 – Identification for Electrical Systems.

3.3 ARC FLASH HAZARD WARNING LABEL

A. Provide arc flash hazard warning label on exterior door of all enclosed circuit breakers 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 262816.16 – ENCLOSED SWITCHES

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 disconnect safety switches 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

G. Section 262813 – Fuses

1.4 SUBMITTALS

A. Manufacturer's product data sheets shall be submitted for each type and size of disconnect safety switch used.

B. Provide dimensioned outline drawing for enclosed switch enclosures.

PART 2 - PRODUCTS

2.1 DISCONNECT SAFETY SWITCHES

A. Each disconnect safety switch shall be 600VAC/300VDC, heavy duty type, single-throw, fusible type as indicated on the Drawings, dual horsepower rated, dead front and front accessible, having a non-teasible positive quick-make, quick-break contact mechanism rated for the voltages indicated on the Drawings.

B. Fusible type disconnect switches shall be designed to allow insertion of UL Class J fuses only. Fuse sizes shall be as indicated on the Drawings.

C. All fusible disconnect switches, size 200 amps and below, shall be equipped with non-metallic fuse pullers.

D. The switch operating handle shall physically indicate the ON and OFF positions of the switch. The switch 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. The switch operating handle shall be an integral part of the switching mechanism, providing permanent control of the contacts, and shall be attached to the box or enclosure base and not to the cover or door.

E. The cover or door shall be mechanically interlocked with the switch operating handle to prevent opening the cover or door when the switch is in the ON position. An interlock override device shall be provided to allow authorized personnel to release the interlock for inspection purposes when the switch is in the ON position.

F. All switch blades shall be fully visible in the OFF position with the enclosure door open.

G. The switch voltage and ampere rating and the number of poles for each disconnect switch shall be as indicated on the Drawings.

H. Terminal lugs shall be copper and shall be Underwriters' Laboratories (UL) listed as being suitable for copper 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.

I. Heavy duty switches shall have permanently attached arc suppressors, hinged or otherwise, attached to permit easy access to line-side lugs without removal of the arc suppressors.

J. Each disconnect safety switch shall be equipped with a copper grounding bar or lugs that is/are bonded to the switch enclosure for termination of all copper equipment grounding conductors entering or leaving enclosure.

K. An electrical interlock for wiring into a control circuit shall be provided on each disconnect safety switch. The interlock shall have one (1) normally open and one (1) normally closed set of contacts which shall be mechanically operated from the switch mechanism, breaking the control circuit before the main switch blades break (open) and making the control circuit before the main switch blades make (close). The contacts shall be rated 120 volts AC/DC, 15 amperes continuous, 60 hertz.

L. Switch enclosures shall be NEMA Type 1 steel without knockouts and with ANSI 49 or ANSI 61 gray paint finish.

M. All enclosures shall meet UL Standard 98, shall be UL listed and labeled, and shall meet the applicable requirements of Federal Specifications WS-865c and NEMA Specifications KS1-1983.

N. Safety switch approved manufacturers are: Square D Type H Series, Eaton Type DH Series, ABB Type TH Series or Siemens HF Series.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide fused disconnect switches, where required by NFPA 70, where indicated on Drawings, and where required by equipment manufacturer, in a location convenient for maintenance on each switch and adjacent equipment.

B. Provide UL Class J fuses in accordance with Specification 262813 – Fuses having the ampere rating indicated on the Drawings.

C. Mount enclosed switches on U-channel supports in accordance with Section 260529 – Hangers and Supports for Electrical Equipment where indicate on the Drawings.

D. Install fuses in fuse clips with fuse label, indicating fuse type, voltage and ampere rating, facing out.

3.2 IDENTIFICATION

A. Mounted on the outside surface of each disconnect safety switch door shall be a three-layer engraved laminated plastic nameplate meeting the requirements of Section 260553 – Identification for Electrical Systems.

END OF SECTION 262816.16

SECTION 262913.13 – ACROSS-THE-LINE MOTOR CONTROLLERS

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 individual three-phase motor starters 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

G. Section 262813 – Fuses

1.4 SUBMITTALS

A. Manufacturer's product data sheets shall be submitted on each type of across-the-line motor controller.

B. Data sheets shall include the following:

1. Outline drawing of motor controller enclosure, indicating NEMA Type
2. Schematic diagram, with wire and terminal numbers
3. Bill of Material for components

PART 2 - PRODUCTS

2.1 GENERAL

A. All motor controllers and motor control components shall be NEMA design and horsepower rated. IEC design will NOT be acceptable.

B. The NEMA size of each motor controller shall be shown on the Drawings.

C. All individual three-phase motor starters shall be the combination type consisting of a fusible disconnect switch and an electrically held, 208-volt AC magnetic contactor, vertical action solenoid

type. Contactors and switch shall be dual horsepower and continuous current rated for the indicated NEMA starter size.

D. Combination type motor controllers having a non-fusible disconnect switch, circuit breaker or motor circuit protector are not acceptable.

E. All contactor coils shall be rated for 120 volts, 60 hertz.

2.2 DISCONNECT SWITCH

A. The motor controller disconnect switch shall be heavy duty type, single-throw, fusible, dual horsepower and continuous current rated for the indicated starter size, dead front, externally operated front accessible with visible blades, and having a non-teasible positive quick-make, quick-break contact mechanism rated for the current indicated on the Drawings.

B. The switch operating handle shall physically indicate the ON and OFF positions of the switch. The handle shall also be able to accept three padlocks having heavy duty industrial type shackles 3/8-inch thick and be padlocked either in the ON or OFF position.

C. The switch operating handle shall be an integral part of the switching mechanism, providing permanent control of the contacts, and shall be attached to the box or enclosure base and not to the cover or door.

D. The cover or door shall be mechanically interlocked with the switch operating handle to prevent opening the cover or door when the switch is in the ON position. An interlock override device shall be provided to allow authorized personnel to release the interlock for inspection purposes when the switch is in the ON position.

E. All switch blades shall be fully visible in the OFF position with the enclosure door open.

F. The switch ampere rating and the number of poles shall be as indicated on the Drawings.

G. Terminal lugs shall be Underwriters' Laboratories listed as being suitable for copper cables 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.

H. Fuse clips shall be positive pressure cartridge type and shall accommodate the classification and sizes of fuses as indicated on the Drawings and/or as specified in these Specifications. Fuse rejection type clips shall be provided to allow insertion of Underwriters' Laboratories Class J fuses only.

I. Heavy duty switches shall have permanently attached arc suppressors, hinged or otherwise, attached to permit easy access to line-side lugs without removal of the arc suppressors.

2.3 MOTOR CONTACTORS

A. All individual three-phase across-the-line motor controllers include a NEMA rated, full voltage, non-reversing, single speed, 3-pole magnetic contactor.

B. Each motor controller shall be provided with a minimum of one normally open and one normally closed auxiliary contacts. Additional auxiliary contacts shall be provided as indicated on the Drawings or as necessary for meeting the control circuit requirements.

C. A Surge Suppressor shall be mounted directly across the coil terminals of all contactors and starters which interface with solid state components, to limit voltage transients.

D. All 120-volt AC Surge Suppressors shall be Allen-Bradley Company Catalog No. 599-KO4 or 199-FSMA1; or approved equal.

2.4 MOTOR OVERLOAD PROTECTION

A. Provide three-pole overload relay with an external manually operated reset mechanism mounted on the starter door.

B. Overload relays shall be NEMA rated, self-powered, ambient temperature compensated or ambient temperature insensitive solid state type with field selectable Class 10 or Class 20 trip and integral phase loss and ground fault protection.

C. Overload trip current range shall be field adjustable and adjustment range should be such that the FLA of the motor to be protected falls near the mid-point.

D. Solid state overload relays shall be Eaton Model 440, Square D MotorLogic Class 9065 or approved equal by Allen-Bradley or ABB.

2.5 MOTOR CONTROLLER PROTECTION

A. Motor controllers shall be protected from short circuits by dual element, time delay, current limiting fuses to provide Type 2 protection. This level of protection shall allow no damage to the controller, under low and high level fault conditions.

2.6 CONTROL POWER

A. All control power shall be 120 volts, 60 hertz.

B. Each motor controller unit shall contain a 208V/120V control voltage transformer, as required based on connection voltage of the starter, of adequate size to obtain 120-volt control power, unless otherwise indicated.

C. The control power transformer shall be provided with one secondary line fused and the other secondary line grounded. A properly sized fuse shall be provided in each 208-volt primary conductor to the control power transformer.

2.7 CONTROL DEVICES

A. Push buttons, selector switches and pilot lights shall be provided in each motor controller door as indicated herein.

B. Each motor controller shall have a “HAND-OFF-AUTO”, 3-position, maintained contact selector switch, a red "RUN" pilot light and a green “OFF” pilot light mounted on the exterior side of the starter door. Pilot lights shall be wired through a starter contactor auxiliary contact. Parallel connection of the "RUN" pilot light across the contactor coil is not acceptable.

C. Pilot light units shall be NEMA Type 4/4X/13 (watertight/corrosion-resistant/oiltight), 30 or 30.5 mm round plastic, panel mounted, 120 volts AC, push-to-test, full voltage type using 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.

D. Push button units shall be NEMA Type 4/4X/13 (watertight/corrosion-resistant/oiltight), 30 or 30.5 mm round plastic, panel mounted. "START" push button units shall have a fully guarded or flush green button. "STOP" push button units shall have an unguarded or extended red button.

E. Selector switches shall be NEMA Type 4/4X/13 (watertight/corrosion-resistant/oiltight), 30 or 30.5 mm round plastic, three-position, maintained contact, panel mounted with the Standard Operator, unless otherwise indicated.

F. 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.

G. Any additional control relays, timing relays, and other devices, as indicated on the Drawings, shall be provided inside the starter enclosure.

2.8 ENCLOSURES

A. Mounted on the exterior surface of each motor controller shall be an engraved laminated plastic nameplate in accordance with Section 260553 – Identification for Electrical Systems.

B. Motor controller enclosures shall be NEMA Type 4X, Type 304 or 316 stainless steel, unpainted with external mounting tabs or mounting flanges at the top and bottom of the enclosure.

C. Unless otherwise indicated, all internal control wiring shall be size 14 AWG minimum stranded copper conductors having 600-volt, 75ºC minimum insulation.

D. All wiring going to remote items shall leave the motor controller enclosure via terminal blocks.

2.9 APPROVED MANUFACTURERS

A. Individual full voltage, non-reversing, single-speed, three-phase motor starters shall be:

1. ABB Catalog CR308
2. Eaton Series ECN18
3. Square D Class 8538
4. Approved equal by Allen-Bradley

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fuses in motor controller disconnect switches and control fuse clips with fuse label, indicating fuse type, voltage and ampere rating, facing out such that the information is visible for inspection without removing the fuse from the fuse clips.

B. Motor controllers shall be mounted to stainless steel U-strut supports, in accordance with Section 260529 – Hangers and Supports for Electrical Equipment, using the factory furnished mounting tabs/flanges on the enclosure. Drilling mounting holes in the enclosure will void the UL Listing and the NEMA rating of the enclosure and will require the enclosure to be replaced.

C. All rigid metal conduits which terminate at motor controllers shall terminate in stainless steel, insulated throat, grounding type, liquid tight rigid conduit hubs. Conduit hubs shall be provided in accordance with Section 260533.13 - Conduit for Electrical Systems and bonded to the motor

controller equipment ground bus in accordance with Section 260526 - Grounding and Bonding for Electrical Systems.

D. Provide NEMA 4X gasketed hole seals for all unused conduit openings in the top, bottom, sides or back of all motor controller enclosures.

3.2 MOTOR OVERLOAD PROTECTION

A. The Contractor shall adjust the overload relay trip setting for each motor in accordance with the National Electrical Code (NEC) and per the solid state overload relay manufacturer's instructions. All motor nameplates shall be checked for the full load current rating and allowable temperature rise to determine the correct overload relay setting for the corresponding starter.

B. It shall be the Contractor's responsibility to ensure that the motor starter overload relay is properly set for each motor to suit the particular application and environment of the motor and respective starter. To this extent, the Contractor shall consult with the manufacturer of the motor and the equipment being driven by the motor, to ensure that the overload relay is set properly.

C. The Contractor shall "seal" all overload relay adjustments to prevent unauthorized personnel from changing settings using Square D "TUSEAL," or approved equal, trip unit seals.

END OF SECTION 262913.13

SECTION 28 31 11 –ADDRESSABLE FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Related Documents: Drawings, General and Supplementary Conditions apply to the work of this section.

1.2 SUMMARY

A. Section includes the following:

1. Intelligent / Addressable Fire Alarm Control Panels
2. Digital Alarm Communicator Transmitter
3. Cellular Communicator
4. Power Supplies
5. Networking
6. Circuits
7. System Smoke Detectors
8. System Heat Detectors
9. Carbon Monoxide (CO) Detectors
10. Manual Pull Stations
11. Addressable Interface Modules
12. Notification Appliances
13. Alarm Verification
14. HVAC Shutdown
15. Remote Annunciators
16. Documentation Cabinet
17. Electromagnetic Door Hold Open
18. Transient Suppression Modules

1.3 DEFINITIONS

A. AHJ: Authority Having Jurisdiction

B. BAS: Building Automation System

C. DACT: Digital Alarm Communicator Transmitter

D. FACP: Fire Alarm Control Panel

E. FAEM: Fire Alarm Equipment Manufacturer

F. FATP: Fire Alarm Transponder Panel

G. FM Global: Factory Mutual Global

H. IDC: Initiating Device Circuit

I. NAC: Notification Appliance Circuit

J. NICET: National Institute for Certification in Engineering Technologies

K. NFPA: National Fire Protection Association

L. NRTL: Nationally Recognized Testing Laboratory

M. SLC: Signaling Line Circuit

N. UL: Underwriters Laboratories, Inc.

1.4 REFERENCES

A. All work shall be installed in accordance with all applicable codes and referenced design standards:

1. 2012 Building Code with local amendments
2. 2012 Fire Code with local amendments
3. 2012 Mechanical Code with local amendments
4. 2010 NFPA 72, National Fire Alarm & Signaling Code
5. 2011 NFPA 70, National Electrical Code
6. 2012 NFPA 101, Life Safety Code
7. ADA - Americans with Disabilities Act
8. FM Global Recommended Practices
9. 19 CSR 30-86 State / Local Standards

1.5 SYSTEM OPERATIONAL DESCRIPTION

A. The fire alarm system shall be a non-coded, documented addressable system, with automatic sensitivity control of certain smoke detectors and multiplexed signal transmission, dedicated to fire alarm service only.

B. System Operation shall be as follows:

1. Upon loss of building power, the entire system shall transfer to secondary power within ten (10) seconds, and without loss of signals. The system shall operate under secondary power in normal or trouble conditions for twenty-four (24) hours and have sufficient power to support complete alarm condition operation for a subsequent five (5) minutes of evacuation alarm operation at maximum connected load.
2. Abnormal circuit conditions or devices, as required for the Class of the circuit, shall initiate a "trouble" condition at the control panels for that specific circuit or device. The “trouble” indication shall describe the nature of the condition on the affected circuit or device. The fire alarm system shall transmit a general "trouble" condition to the main FACP located in the Donnelly Building.
3. Activation of any supervisory device as indicated on the engineering drawings shall initiate a "supervisory" condition at the control panels for that specific device. The "supervisory" indication shall describe the nature of the condition and specific address and alphanumeric description of the device affected. The fire alarm system shall transmit a general "supervisory" condition to the main FACP located in the Donnelly Building.

4. Activation of any alarm device as indicated on the engineering drawings shall initiate an "alarm" condition at the control panels and remote annunciators for that specific device. The "alarm" indication shall describe the nature of the condition and specific address and alphanumeric description of the device affected. The fire alarm system shall transmit a general “alarm” condition to the main FACP located in the Donnelly Building.

C. Initiation of an "alarm" condition shall result in the following functions to be performed by the system:

1. Initiate an alarm indication on the control panel by tone and illuminate the corresponding device specific alphanumeric LCD description. Manually activating the "Alarm Silence" shall silence the tone at the panel. The alarm alphanumeric display shall remain "On" at the control panel until the condition causing the alarm has been cleared and reset. An additional alarm reported to the panel subsequent to activating the "Alarm Silence" shall reactivate the control panel tone.
2. Activate the audible and visual notification appliances throughout the affected building.
3. Manually activating the "Alarm Silence" at the panel shall de-energize the audible and visual notification appliances. An additional alarm reported to the panel subsequent to activating the "Alarm Silence" shall re-energize the audible and visual notification appliances throughout the affected building.
4. Each individual building transmits a general “alarm” signal to the Main FACP in the Donnelly Building.
5. The main FACP in the Donnelly Building transmits a general “alarm” signal to the approved remote monitoring station.
6. Cellular communicator shall provide notification via text messages and emails to the predetermined contacts list. A predetermined contacts list shall be coordinated with the facilities supervisor.
7. Release all affected door hold open devices.

D. Actuation of alarm notification appliances, fire safety functions, and annunciation at the protected premises shall occur within ten (10) seconds after the activation of an initiating device.

E. Activation of a Carbon Monoxide (CO) detector shall activate a four-pulse temporal pattern audible alarm signal in accordance with NFPA 720.

F. Additional indications, notifications, enabling functions or control functions shall be as indicated on the engineering drawings.

1.6 DESCRIPTION OF WORK

A. Provide all required labor, warranty labor, materials, equipment, system programming, testing, submittals and services necessary for a complete and operational fire alarm system as hereinafter described, and as shown on the engineering drawings.

B. Provide a minimum of ten (10) hours training, for staff personnel, in the operation and use of the system.

C. It is intended that the engineering drawings and specifications shall describe and provide for a working installation complete in every detail and all items necessary for such complete installation shall be provided whether or not specifically mentioned herein or shown on the engineering drawings.

1.7 PERFORMANCE REQUIREMENTS

A. Seismic Performance

1. The fire alarm control panel and raceways shall withstand the effects of earthquake motions as determined by SEI/ASCE 7.

a. The term "withstand" is defined as "the panel will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will remain fully operational after the seismic event."

1.8 SUBMITTALS

A. The engineering drawings have been prepared using AutoCAD. These documents will be made available either in electronic or hard copy form. Utilization of these documents for the development of shop drawings and submittals does not relieve the Contractor from any responsibilities required herein.

B. In the submittals, the Contractor must clearly identify all areas and sections of this specification to which they take exception or are not capable of providing.

C. Submittals will be disapproved unless required equipment literature, calculations, and complete shop drawings are submitted together as one package for review.

D. The Engineer shall review the Contractor's submittals to verify conformance to the project specifications and design concepts expressed in the contract documents. The Contractor shall allow sufficient time to permit adequate review. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of details and dimensions, or substantiating installation or performance of equipment and systems designed by the Contractor, all of which remain the Contractor's responsibility to the extent required by the contract documents. The Engineer's review shall not constitute approval of safety precautions of construction, means, methods, techniques, sequences of procedures, or approval of a specific assembly.

E. Prior to release of equipment for shipment or installation, submit to the Engineer the following:

1. Shop Drawings. The specific quantity to be submitted shall be confirmed with the General Contractor and Owner. Electronic submittals are acceptable. Submittal must be comprehensive of the entire project, complete in all detail, and include, but not be limited to, the following:

a. Floor plans showing equipment placement, point to point wiring, wiring types and sizes, conduit types and sizes, wiring and raceway routes, and proposed mounting methods for conduit and backboxes. Floor plans shall be AutoCAD generated.
b. Sequence of Operations in Matrix form to include a detailed description of the operation of each system function for all possible conditions.
c. Audibility and intelligibility testing procedures. Testing procedures shall include a list of testing equipment, certificates of calibration, methods of measurement with minimum score, acceptability criteria and calibration procedure.
d. Design minimum for audibility level for occupant notification.

e. Riser diagram showing typical wiring connections for each type of device and module.
f. Detailed wiring diagrams for major system components (control panels, transponder panels, power supplies, amplifiers, etc.).
g. Supervisory and alarm current calculations for primary power and emergency battery sizing of all control panels and auxiliary power supplies.

1) Battery calculations shall list the type of devices and modules, quantities, amperage draw for standby and alarm conditions for each device, the total amperage draw for each panel, and each panel's battery amp/hour rating.
2) The calculated load shall be the design load, including all required spare capacity.
3) The battery calculations shall include a twenty-five (25) percent correction factor for aging to ensure the battery can meet its current demand at the end of service life.

h. A complete list of all proposed alphanumeric descriptions and their associated point address and circuit number.

i. Voltage drop calculations for all notification appliance circuits.

1) Calculations shall follow the voltage drop calculation criteria as outlined in NFPA 72 and UL 864.
2) Calculations shall use the worst case operating voltage of each control panel or power supply as a starting voltage. The starting voltage shall be 20.4 VDC, unless written documentation is provided confirming that the specific control panel or power supply is capable of maintaining a voltage higher than 20.4 VDC.
3) Calculations shall use the lowest operating voltage of the notification appliances and the associated increased current draw. The lowest operating voltage shall be the UL standard operating voltage of 16 VDC, unless approved otherwise by the Engineer.

2. Manufacturer's literature on all system equipment. The specific quantity to be submitted shall be confirmed with the General Contractor and Owner. Electronic submittals are acceptable.

a. Literature shall include specification and description of recommended supporting methods, enclosures or boxes, and wiring connections.
b. The exact components to be utilized on this specific project shall be indicated, by highlighting or arrows, on each data sheet of the equipment literature.
c. Literature which is not clearly identified will be rejected.
d. UL FHIT System number and associated installation criteria for all Circuit Integrity (CI) or Circuit Integrity in Conduit (CIC) systems.

3. Qualifications and authorization of the representative of the FAEM.

F. The Engineer shall review for accuracy all submittals required to be received by the Engineer prior to equipment release or installation. The Owner, Owner's Representative, or design firms retained by the Owner shall not be responsible for any additional costs resulting from replacement of equipment or materials not reviewed prior to installation.

G. After satisfactory review of the submittals by the Engineer, the Contractor shall submit all required drawings, manufacturers' literature, calculations and any other materials required by the AHJ to obtain a permit to the appropriate party for review.

H. Forward to the Engineer a copy of the transmittal of the permit application.

I. Forward to the Engineer, in writing, any comments from the AHJ or the Insurance Underwriter within five (5) working days after the receipt of their comments.

J. Forward to the Engineer a copy of the UL Central Station Supervisory Center Certificate.

1.9 PROJECT RECORD DOCUMENTS

A. The Contractor shall provide and maintain on site an up-to-date record set of satisfactory shop drawings which shall be marked to show each and every change made to the fire alarm system from the original approved shop drawings. This shall not be construed as authorization to deviate from or make changes to the shop drawings reviewed by the Engineer without written instructions from the Engineer in each case. This set of drawings shall be issued only as a record set. These drawings shall be made available to the Owner, or the Owner's Representative, upon request.

B. The preparation of a record of completion shall be the responsibility or the qualified and experienced installation personnel, as indicated in NFPA 72.

C. The preparation of a record of completion shall be in accordance with NFPA 72. Record of completion shall include, but not be limited to, the following:

1. A final copy of the record of completion shall be provided after completion of the operational acceptance tests.
2. One copy of the record of completion shall be stored at the fire alarm control panel or other approved location.
3. This copy shall be updated to reflect all system additions or modifications and maintained in a current condition at all times.
4. Where not stored at/adjacent to the main fire alarm control panel, the location of these documents shall be identified at the main fire alarm control panel.
5. If the documents are located in a separate enclosure or cabinet, the separate enclosure or cabinet shall be prominently labeled "FIRE ALARM DOCUMENTS".

D. The Contractor shall continually document software and programming changes. This documentation shall include:

1. A complete printout of the system prior to the change.
2. A complete printout of the system program subsequent to the change, with all modifications highlighted.
3. A letter prepared and signed by the individual who made the changes, describing each change made and the reason for the change. This letter shall certify that the programmer has personally reviewed and compared the before and after program printout and verified the correctness of the modification(s).
4. An equivalent means performed automatically in computer software, which verified the results of changes made is acceptable.

E. All fire alarm system modifications made after the initial installation shall be recorded on a revised version of the original record of completion, as indicated in NFPA 72.

F. Once the fire alarm system is put into service, in whole or in part, and the associated building(s) are partially or wholly occupied, no software changes shall be performed without prior written permission of the Owner, or Owner's Representative.

G. Only a certified manufacturer's representative trained in the specific programming software shall make changes to the fire alarm system software once the system is in service.

H. Each revision to the software shall be identified by a unique version number and date.

I. Prior to final payment for the fire alarm system and the beginning of the warranty period, submit a CD ROM and two (2) sets (or as directed by the Owner's Representative) of the following completed project record documents to the Owner's Representative:

1. Copies of all test and inspection reports as required by the AHJ and NFPA 72:

    a. The Record of Completion form shall be in the format as outlined in NFPA 72.
    b. The Inspection and Testing form shall be in the format as outlined in NFPA 72.

2. All permits and licenses required to be in the possession of the Owner by the AHJ.
3. Accurate record (as-built) drawings of the complete installation to include, but not be limited to, the information required for the shop drawings. Record drawings of the floor plans shall be AutoCAD generated.
4. Original warranty documents including, but not limited to, those of the FAEM. Warranty documents shall reference and be binding to the warranty provisions specified in the warrant portion of this specification.
5. Submit to the Engineer a copy of the transmittal to the Owner's Representative for all final complete project record documents.

J. Upon completion of construction, submit two (2) sets and a CD ROM of equipment warranties and two (2) sets and a CD ROM of installation, operations and maintenance instructions to the Owner's Representative. This manual shall reflect the completed installation and include, but not be limited to the following information:

1. A detailed narrative description of the systems architecture, inputs, evacuation signaling, auxiliary functions, annunciation, sequence of operation, expansion capability, application considerations and limitations.
2. A detailed description of routine maintenance required or recommended, or as would be provided under a maintenance contract, including a testing schedule and detailed maintenance instructions for each type of device installed
3. Detailed troubleshooting instructions for each possible trouble condition.
4. An equipment list/schedule detailing all equipment and quantities installed. The manufacturer's product model/identification number shall be shown next to each piece of equipment on the list.
5. Updated manufacturer's data sheets and installation manuals/instructions for all equipment installed.
6. Updated list of spare parts and accessories recommended by the manufacturer shall be stocked for maintenance of the system.

7. A detailed description of the operation of the systems, including operator responses. Copies of the approved sequence of operation shall be placed in the security office.

K. A copy of all software documentation required by this section shall be maintained on-site by the Contractor, in a binder, arranged in chronological order. This binder shall be provided to the Owner's Representative at the completion of the project.

1.10 QUALITY ASSURANCE

A. All work shall meet the requirements of the Owner, Architect, Engineer and Authority Having Jurisdiction (AHJ).

B. All equipment and components shall be UL listed, for the actual intended use, unless hereinafter specifically excluded from such a listing.

C. Installation and supervision of installation shall be in strict compliance with the requirements of the regulations, licenses, and permits for fire alarm system installers in this jurisdiction.

D. Installer must have been actively engaged in the business of selling, installing, and servicing fire alarm systems for at least five (5) years.

E. Installer must be an authorized representative of the FAEM and have technical factory training specifically for the system proposed.

F. The FAEM shall have a representative supervise the final connection of devices, wiring, and programming of the control panels. The FAEM representative shall be NICET certified as Level II or higher Fire Alarm Protection / Fire Alarm Systems Engineering Technician.

G. Obtain documentation according to NFPA 72 by a UL listed company.

1.11 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.

B. Beginning with Substantial Completion (as determined by the Owner), provide software support for two (2) years.

C. Update software to latest version at Project completion. Install and program software upgrades that become available within two (2) years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.

1. Provide minimum thirty (30) days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

1.12 REGULATORY REQUIREMENTS

A. All work shall meet the requirements of all applicable codes and referenced design standards.

B. No approvals or interpretations of the design documents shall be pursued except through the Engineer.

C. Any work performed prior to the satisfactory review of the shop drawings by the Engineer, approval by the AHJ, and determined to be noncompliant with the contract documents or applicable codes by the Owner or AHJ will be replaced at the Contractors' expense.

D. The system will not be acceptable until final testing and receipt of the Inspection and Testing Form has been obtained.

1.13 PROJECT CONDITIONS

A. Interruption of Existing Fire Alarm Service

1. The interruption of fire alarm service to the facilities occupied by Owner or others is unacceptable unless as permitted by the Construction Manager and only after arranging for temporary guard service. The procedures for interruption of fire alarm services are as follows:

    a. Notify Owner a minimum of two (2) days in advance of proposed interruption of fire alarm service.
    b. Do not proceed with interruption of fire alarm service withoutOwner's written permission.

1.14 SEQUENCING AND SCHEDULING

A. Existing Fire Alarm Equipment Replacement

1. Ensure existing equipment remains fully operational until new equipment is operational, tested and accepted.
2. As new equipment is installed, the equipment shall be labeled "NOT IN SERVICE" until the new equipment is accepted.
3. Remove labels from new equipment when the new equipment is put into service and the existing fire alarm equipment is labeled "NOT IN SERVICE" or removed from the building.

B. Existing Equipment Removal

1. Once the acceptance of the new fire alarm system, the existing fire alarm equipment and wiring can be disconnected and removed.

1.15 WARRANTY

A. Repair all defective workmanship or replace all defective materials for a period of one (1) year from the date of acceptance by the Owner's Representative. Workmanship or equipment found to be defective during that period shall be replaced at no additional cost to the Owner.

B. The warranty or any part of the warranty shall not be made void by any required operation or inspection of the system after acceptance during the warranty period. The Owner may select qualified firms other than Warrantor to provide required tests and inspections. System testing and inspections will be conducted only by a duly licensed company under contract with the Owner to perform scheduled testing and inspections as required by the AHJ. The Owner may elect to have a representative present at the scheduled testing during the warranty period.

1.16 POST CONTRACT MAINTENANCE

A. As part of the bid/proposal, include a quote for a maintenance contract to provide all maintenance, required tests, and list pricing for any replacement products included on the bill of materials, along with the list pricing for products not on the bill of materials; if test and inspection rates are different than full service rates the bid/proposal shall include pricing for all levels for a minimum period of five (5) years Rates and costs shall be valid for the period of five (5) years after expiration of the guaranty.

B. As part of the bid/proposal, include a quote for unscheduled maintenance/repairs, including hourly rates for technicians trained on this equipment, and response travel costs for each year of the maintenance period. Rates and costs shall be valid for the period of five (5) years after expiration of the guaranty.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Notifier NFW-50X / NFW-100X

2.2 FIRE ALARM CONTROL PANELS

A. General Requirements for the FACP:

1. Provide control panels that consist of modular components, utilizing solid state programmable microprocessors, to accomplish all system functions. The main control panel and any additional control panels shall be provided in sufficient quantity as to perform all functions in this specification. Transponders will be acceptable in lieu of additional control panels if the main control panel and transponder panels are capable of performing all of the functions in this specification. The components shall include but not be limited to the following items:

    a. Non-volatile RAM memory that provides for no program loss if a primary and secondary power loss occurs.
    b. An integral display with a minimum eighty (80) characters liquid crystal display (LCD). Provide light-emitting diodes (LED) for AC power, system alarm, system trouble, display trouble and disable. The display shall be visible through the control panel cabinet's transparent window. The processor shall be capable of displaying historical log data; current system status information; and all individual device addresses, descriptions and conditions on the integral display.
    c. The system shall provide a four hundred (400) event historical log on command of all alarms signals, supervisory signals, trouble signals, monitor point changes-in-state, operator commands and system initiated control functions.

d. System core shall have processing capability to support the addressable points including the necessary software, programming, and motherboard/expansion card sockets. Core system shall include a minimum of one (1) signaling line circuits (SLC) as indicated on the engineering drawings. Total system capacity shall support a minimum fifty (50) addressable points. No SLC device or module loop shall be assigned more than eighty (80) percent of its point capacity unless approved in writing by the Engineer.

e. System processing capable of supporting initiation data circuits which can be "T-tapped" at any location on the signaling line circuit (SLC). Any additional modules, programming, or circuits required to achieve the specified system capacity shall be provided and installed at no cost to the Owner.

f. Interface for peer-to-peer operation with automatic default to stand-alone mode if failure occurs in any processor, internal connection, or module.

g. Control panels shall be capable of including an interface for supervised remote annunciators.

h. System processing capable of supporting addressable analog smoke detection, addressable analog heat detection, addressable pull stations, addressable monitoring modules, and remote addressable control modules.

i. Capability of controlling the state of contacts located in remote addressable modules, detector base-mounted programmable relays, and outputs on the panel including all necessary hardware and software.

j. Detection of removal, disconnection, or failure of any control panel module.

k. Capability of adjusting the smoke detector sensitivity from the control panel. The control panel shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings.

    1) The control panel shall be capable to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups.
    2) Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.

l. Provide a "maintenance alert" feature whereby the detector initiates a trouble condition should the detectors' sensitivity approach the outside limits of the normal sensitivity window.

m. Provide power supplies, transformers, batteries, battery chargers and modules required for a complete and operational system.

    1) Primary power shall be 24 VDC obtained from 120 VAC dedicated service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, and supervisory signals shall be powered by 24-V dc source.
    2) Secondary power shall be 24 VDC supply system with batteries, automatic battery charger, and automatic transfer switch.

        a) Batteries: Sealed, valve-regulated, recombinant lead acid.

    3) Power supply capacity shall not exceed eighty (80) percent of its rated (continuous) capacity.

a) Alarm current draw of entire fire alarm system shall not exceed 80 percent of the power-supply module rating.

4) Provide sufficient output power to the devices to perform the specified functions as shown on the engineering drawings.

n. Provide a UL listed cabinet with sufficient space and circuit board slots for the specified equipment. The cabinet shall have a hinged door keyed in common with all other keyed devices throughout the system. If multiple cabinets are required in one location, the cabinets shall be located adjacent to each other and match in finish and design.

B. Circuits:

1. Initiating Device Circuits (IDC) shall meet the minimum requirements of Class B.
2. Notification Appliance Circuits (NAC) shall meet the minimum requirements of Class B. Addressable notification appliances are not acceptable.
3. Signaling Line Circuits (SLC) shall meet the minimum requirements of Class B.
4. Circuits for relay coil operation shall be 24 volt maximum with a separate or integral field collapsing diode.
5. The control panels and auxiliary power supplies shall receive their power from 120 volt AC dedicated branch circuits. The circuit disconnecting means shall:

   a. Have a red marking.
   b. Have a listed breaker locking device.
   c. Be accessible only to authorized personnel.
   d. Be identified as “FIRE ALARM”.

6. The 24 volt DC power for all system initiation, supervisory, notification and control circuits shall be provided by the fire alarm control panel power supplies or listed auxiliary power supplies.

C. Pathway Survivability:

1. Pathway survivability shall be as indicated in the engineering drawings.
2. All pathways shall comply with NFPA 70, National Electrical Code.

2.3 CELLULAR COMMUNICATOR

A. Provide an approved cellular communicator to transmit fire alarm, supervisory and trouble signals to an approved off-site monitoring station. The cellular communicator shall be UL listed for commercial fire reporting to an approved off-site monitoring station, and shall conform to the requirements of NFPA 72.

B. The cellular communicator shall operate from a dedicated 120 volt AC or 24 volt DC source with a listed secondary power source conforming to the same alarm and standby time requirements as the FACP.

C. The cellular communicator shall have the capability of providing single or dual path communications.

D. The cellular communicator shall have the ability to verify of communications path at maximum five (5) minute intervals in accordance with NFPA 72.

E. The communicator shall be able to transmit all signals in the Standard SIA (Security Industry Association) format.

F. The cellular communicator shall have the capability to transmit “general” fire alarm, supervisory, and trouble signal to onsite personnel via two (2) phone numbers and three (3) email addresses. Specific contact numbers and email addresses shall be coordinated with onsite personnel prior to installation and programming.

2.4 AUXILIARY POWER SUPPLIES

A. Provide each auxiliary power supply (APS) in an individual, single, self-contained, lockable cabinet.

B. Input shall be 120 volt AC nominal with an output of regulated 24 volt DC. The APS shall operate from a dedicated 120 volt AC source with a listed secondary power source conforming to the same alarm and standby time requirements as the FACP.

C. Each APS shall be capable of actuation from either the control panel notification circuit, or programmed dry contacts.

D. Each APS shall provide “trouble” indication to the control panel upon loss of AC power, low battery or abnormal conditions on individual output circuits.

E. Each APS shall have a minimum of four (4) Class B and two (2) Class A supervised output notification circuits rated individually at a minimum of two (2.0) amperes available per circuit, with a total output of eight (8.0) amps. The Contractor shall be responsible for all redesign, circuiting, and additional equipment costs to provide the necessary output amperage.

F. Each APS shall have a minimum of twenty (20) percent spare capacity on each circuit,. The twenty (20) percent spare capacity shall be applied assuming the total available current is divided equally between all available circuits.

2.5 SYSTEM SMOKE DETECTORS

A. Intelligent Photoelectric Smoke Detectors

1. Provide analog photoelectric type smoke detectors with the capability to send data, on command, to the control panel representing the analog level of smoke density.
2. Provide a "maintenance alert" feature whereby the detector initiates a trouble condition should the detectors’ sensitivity approach the outside limits of the normal sensitivity window.
3. Provide address-setting means and store an internal identification code for each detector which the control panel can use to identify the type and precise location of the detector.
4. Provide dual alarm and power/status LED's. Flash status LED's under normal conditions, indicating that the detector is operational and in regular communication with the control panel. Both LED's may be placed into steady illumination by the control panel, indicating that an alarm condition has been detected and verified.
5. Provide a low profile design modular detector head with twist-lock base.

B. Intelligent Photoelectric Smoke Detectors for Duct Applications

1. Provide duct mounted analog photoelectric type smoke detectors with the capability to send data, on command, to the control panel representing the analog level of smoke density.
2. Provide detectors operating in air velocities of one hundred (100) fpm to four thousand (4,000) fpm without adverse effects on detector sensitivity.
3. Provide a "maintenance alert" feature whereby the detector initiates a trouble condition should the detectors' sensitivity approach the outside limits of the normal sensitivity window.
4. Provide a molded plastic enclosure with integral conduit knockouts. Provide housing with gasket seals to insure proper seating of the housing to the associated ductwork. Provide sampling tubes that extend across the width of the duct and in compliance with the manufacturer's installation recommendations.
5. Provide address-setting means and store an internal identification code for each detector which the control panel can use to identify the type and precise location of the detector.
6. Provide dual alarm and power/status LED's. Flash status LED's under normal conditions, indicating that the detector is operational and in regular communication with the control panel. Both LED's may be placed into steady illumination by the control panel, indicating that an alarm condition has been detected and verified.
7. Provide a low profile design modular detector head with twist-lock base.
8. Provide a separate addressable control/relay module for any associated control functions.

2.6 SYSTEM HEAT DETECTORS

A. Intelligent Thermal Detectors

1. Provide analog thermal fixed temperature and rate-of-rise detectors utilizing dual electronic thermostats to measure temperature levels in its chamber. The detector shall be capable of sending data, on command, to the control panel representing the analog temperature level.
2. The fixed temperature rating shall be one hundred thirty-five (135) degrees Fahrenheit. The rate-of-rise temperature detection shall be fifteen (15) degrees Fahrenheit per minute.
3. Provide address-setting means and store an internal identification code for each detector which the control panel can use to identify the type and precise location of the detector.
4. Provide dual alarm and power/status LED's. Flash status LED's under normal conditions, indicating that the detector is operational and in regular communication with the control panel. Both LED's may be placed into steady illumination by the control panel, indicating that an alarm condition has been detected and verified.
5. Provide a low profile design modular detector head with twist-lock base.
6. Remote test stations, where indicated on the engineering drawings, shall consist of a key operated switch and indicating LED. The remote test station shall be listed for use with the intelligent thermal detector.

2.7 SYSTEM CARBON MONOXIDE (CO) DETECTORS

A. Addressable Carbon Monoxide Detectors

1. CO detector shall meet UL Standards 268 and 2075.

2. Unit shall be equipped with a status LED's that indicate normal operation and regular communications with the control panel, and alarm condition.
3. CO detector shall transmit end-of-life signal to the control panel.
4. Integral alarm horn shall be rated at 85 decibels at 10 feet.
5. Upon activation of the CO detector, the local sounder base shall transmit a temporal 4 pattern.

B. Addressable Combination Smoke / Carbon Monoxide Detectors

1. Detector shall meet UL Standards 268 and 2075.
2. Provide modular detector head with twist-lock base.
3. Unit shall be equipped with a status LEDs that indicate normal operation and regular communications with the control panel, and alarm condition.
4. CO detector shall transmit end-of-life signal to the control panel.
5. Integral alarm horn shall be rated at 85 decibels at 10 feet.
6. Upon activation of the smoke detector, the occupant notification appliance(s) shall transmit a temporal 3 pattern.
7. Upon activation of the CO detector, the local sounder base shall transmit a temporal 4 pattern.

2.8 INTELLIGENT DETECTOR BASES

A. Intelligent Detector Base

1. Provide a UL listed low profile twist-lock detector base with screw terminals. Provide an output connection in the base to connect an external remote alarm LED.
2. Detector base shall be capable of connecting to the control panel.
3. Provide supervision as required by NFPA 72 and the manufacturer's equipment literature.

B. Intelligent Detector Relay Base

1. Provide a UL listed low profile twist-lock detector base with a pre-wired dry contact (Form C) relay.
2. Detector base shall be capable of connecting to the control panel.
3. The relay shall be capable of operating independently from the control panel.
4. Provide all required power to relay bases.
5. Provide supervision as required by NFPA 72 and the manufacturer's equipment literature.

C. Intelligent Detector Sounder Base

1. Provide a UL listed low profile twist-lock detector base with a pre-wired piezoelectric horn that will produce an audible signal at a minimum of eighty-five (85) dBA at ten (10) feet.
2. Detector base shall be capable of connecting to the control panel.
3. Detector base shall be capable of sounding simultaneously, individually or in any combination.
4. Provide all required power to sounder bases.
5. Provide supervision as required by NFPA 72 and the manufacturer's equipment literature.

D. Intelligent Detector Low Frequency Sounder Base

1. Provide a UL listed low profile twist-lock detector base with a pre-wired sounder that will produce an audible signal at a frequency of 520 Hz +/- 10% square wave tone and at a minimum of seventy-five (75) dBA at ten (10) feet.
2. Detector base shall be capable of connecting to the control panel.
3. Detector base shall be capable of sounding simultaneously, individually or in any combination.
4. Provide all required power to sounder bases.
5. Provide supervision as required by NFPA 72 and the manufacturer's equipment literature.

2.9 MANUAL PULL STATIONS

A. Addressable Manual Pull Stations

1. Provide dual action type manual pull stations. Manual pull stations shall be designed that upon activation, shall initiate a change of status at the control panel. The manual pull stations shall not be automatically resettable and shall include a visible indication of the manual pull station being activated.
2. Provide address-setting means and store an internal identification code which the control panel can use to identify the type of device.
3. Construct of hi-impact red molded Lexan with instructions for station operation in raised white letters.
4. Provide flush mounting of pull stations. Where flush mounting is not possible, bring to the immediate attention of the Engineer of Record for resolution.
5. Provide mounting on backboxes UL listed for use with the pull station.
6. Provide a keyed reset on each pull station.

2.10 ADDRESSABLE INTERFACE MODULES

A. Monitor Modules

1. Provide addressable monitor modules where required to interface with contact alarm devices, or to connect a supervised zone of conventional initiating devices (any normally open dry contact device) to an intelligent SLC loop.
2. Provide address-setting means and store an internal identification code which the control panel shall use to identify the type of device.
3. The addressable module must provide a monitor LED that is visible from outside the cover plate unless otherwise noted or approved. Flash status/power LED under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel. The LED may be placed into steady illumination by the control panel, indicating that an alarm condition has been detected.
4. Provide an automatic test feature to permit functional testing of the device from the main control panel. Indicate results of the test on the LCD display at the control panel.
5. Monitor modules with multiple input contact connections are acceptable if each input is capable of independent programming and functional operation.
6. The factory provided cover plate shall be used.

B. Relay Modules

1. Provide addressable control/relay modules where required to interface with a dry contact (Form C) relay. Provide power for the relay actuation from the intelligent SLC loop.
2. Minimum rating of Form C contacts shall be two (2.0) amperes at 24 volts and one half (0.5) amperes at 120 volts AC.
3. Provide address-setting means and store an internal identification code which the control panel shall use to identify the type of device.
4. The addressable module must provide a monitor LED that is visible from outside the cover plate unless otherwise noted or approved. Flash status LED under normal conditions, indicating that the control module is operational and in regular communication with the control panel. The LED may be placed into steady illumination by the control panel, indicating that an alarm condition has been detected.
5. Control/relay modules with multiple output contact connections are acceptable if each output is capable of independent programming and functional operation.
6. The factory provided cover plate shall be used.

C. Signal Modules

1. Provide addressable signal modules where required to interface with audible or visual notification appliances, or to connect a supervised zone of conventional indicating appliances (any 24 volt DC polarized notification appliance or) to an intelligent SLC loop. Provide notification appliance power through a separate loop from the main control panel or from supervised remote power supplies.
2. Minimum rating of the output current shall be one and a half (1.5) amperes at 24 volts and one half (0.5) amperes at 120 volts AC.
3. Provide address-setting means and store an internal identification code which the control panel shall use to identify the type of device.
4. The addressable module must provide a monitor LED that is visible from outside the cover plate unless otherwise noted or approved. Flash status LED under normal conditions, indicating that the control module is operational and in regular communication with the control panel. The LED may be placed into steady illumination by the control panel, indicating that an alarm condition has been detected.
5. The factory provided cover plate shall be used.

D. Isolation Modules

1. Provide isolation modules to automatically isolate wire-to-wire shorts on an SLC loop. The isolation module shall limit the number of modules or detectors that may render inoperative by a short circuit fault on the SLC loop. Upon a wire-to-wire short circuit the isolation module shall automatically disconnect the shorted circuit from the SLC loop. Upon a correction of the wire-to-wire short, the isolation module shall automatically re-connect the isolated circuit to the SLC loop.
2. The isolation module shall not require any address-setting means and its operation shall be totally automatic. It shall not be necessary to replace or reset the isolation module after its normal operation.
3. The addressable module must provide a monitor LED that is visible from outside the cover plate unless otherwise noted or approved. Flash status/power LED under normal conditions, indicating that the isolation module is operation and in regular communication with the control panel. The LED may be placed into steady illumination indicating a short circuit has been detected and isolated. Where status LED is provided, manufacturer provided cover plate with viewing hole shall be provided.
4. The factory provided cover plate shall be used.

2.11 NOTIFICATION APPLIANCES

A. Visual Notification Appliances - Wall Mounted

1. Provide visual notification appliances operable at 24 volt DC and polarized supervision. The appliances shall utilize a high intensity solid state xenon strobe tube with associated lens/reflector system. The appliances shall be constructed of high-impact red thermoplastic, shall indicate "FIRE", and shall be UL listed for wall mounted applications.
2. Where possible, provide flush mounting of appliances. Where flush mounting is not possible, bring to the immediate attention of the Engineer of Record for resolution. Where surface mounting is necessary, provide a decorative backbox skirt covering the appliance backbox.
3. Provide synchronization of all visual notification appliances. The synchronization modules shall be capable of synchronizing appliances with candela ratings ranging from 15 cd to 185 cd.

B. Visual Notification Appliances - Ceiling Mounted

1. Provide visual notification appliances operable at 24 volt DC and polarized supervision. The appliances shall utilize a high intensity solid state xenon strobe tube with associated lens/reflector system. The appliances shall be constructed of high-impact red thermoplastic, shall indicate "FIRE", and shall be UL listed for ceiling mounted applications.
2. Where possible, provide flush mounting of appliances. Where flush mounting is not possible, bring to the immediate attention of the Engineer of Record for resolution. Where surface mounting is necessary, provide a decorative backbox skirt covering the appliance backbox.
3. Provide synchronization of all visual notification appliances. The synchronization modules shall be capable of synchronizing appliances with candela ratings ranging from 15 cd to 185 cd.

C. Audible/Visual Notification Appliances - Wall Mounted

1. Provide solid state electronic audible notification appliances with integral visual notification appliance operable at 24 volt DC and polarized supervision. The appliances shall utilize a high intensity solid state xenon strobe tube with associated lens/reflector system. The appliances shall be constructed of high-impact red thermoplastic, shall indicate "FIRE", and shall be UL listed for wall mounted applications.
2. Where possible, provide flush mounting of appliances. Where flush mounting is not possible, bring to the immediate attention of the Engineer of Record for resolution. Where surface mounting is necessary, provide a decorative backbox skirt covering the appliance backbox.
3. Provide synchronization of all audible and visual notification appliances. Provide a synchronized temporal pattern audible tone producing a minimum sound pressure level of seventy-five (75) dB reverberant per UL 464 using the A-weighted scale (dBA). The synchronization modules shall be capable of synchronizing appliances with candela ratings ranging from 15 cd to 185 cd.

D. Audible/Visual Notification Appliances - Ceiling Mounted

1. Provide solid state electronic audible notification appliances with integral visual notification appliance operable at 24 volt DC and polarized supervision. The appliances shall utilize a high intensity solid state xenon strobe tube with associated lens/reflector system. The appliances shall be constructed of high-impact red thermoplastic, shall indicate "FIRE", and shall be UL listed for ceiling mounted applications.
2. Where possible, provide flush mounting of appliances. Where flush mounting is not possible, bring to the immediate attention of the Engineer of Record for resolution. Where surface mounting is necessary, provide a decorative backbox skirt covering the appliance backbox.
3. Provide synchronization of all audible and visual notification appliances. Provide a synchronized temporal pattern audible tone producing a minimum sound pressure level of seventy-five (75) dB reverberant per UL 464 using the A-weighted scale (dBA). The synchronization modules shall be capable of synchronizing appliances with candela ratings ranging from 15 cd to 185 cd.

2.12 MISCELLANEOUS

A. Transient Voltage Surge Suppression Modules (TSM)

1. Provide transient voltage surge suppression modules consisting of silicon avalanche suppressor diode (SASD) technology. Modules shall be designed, manufactured and installed in accordance with UL 497B, the National Electrical Code, and the manufacturer's instructions.
2. Performance specifications shall include a Response Time of less than five (5) nanoseconds.

B. Transformer

1. Provide a UL listed step-down transformer with a primary input voltage 120 volt AC and a secondary output voltage 24 volt AC at a minimum of 25 VA. The transformer shall have enclosed pigtail type primary connections and screw type secondary terminal connections.
2. Provide a fusible device to be connected to the secondary/load side of the transformer for protection of the wiring and devices connected to the transformer. The amperage of the fusible device shall be based on the projected load and a twenty-five (25) percent safety factor.

C. Device Guards

1. Provide a welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection. Factory fabricated and furnished by manufacturer of device or an approved equal.

D. End of Line Power Supervision Relay

1. Provide a multi-voltage relay (FORM-C (SPDT)) with terminal strip field wiring connections, mounting track and hardware.
2. The relay shall have an operating voltage of 120VAC.
3. Relay shall have a red LED indicating the Relay Coil is energized.
4. Acceptable manufacturer is System Sensor R-10T.

E. End of Line Power Supervision Relay

1. Provide a single pull single throw (SPST) normally open relay that can be used as an end of line device to supervise the duct smoke detectors.
2. The relay shall have an operating voltage of 24VDC.
3. Acceptable manufacturer is System Sensor EOLR-1.

F. Documentation Cabinet

1. Provide a documentation cabinet of 16 Gauge Steel construction.
2. Where possible, provide flush mounting of documentation cabinet. Where flush mounting is not possible, bring to the immediate attention of the Engineer of Record for resolution.
3. The documentation cabinet shall be red in color with contrasting text indicating FIRE ALARM DOCUMENTS.
4. The documentation cabinet shall be lockable and keyed in common with all other keyed devices throughout the system.
5. The documentation cabinet shall be sized to contain the following: full size record drawing, equipment data sheets, firmware and software control documentation.

2.13 SPARE PARTS

A. Initiating Devices: Provide a quantity equal to ten (10) percent of the number of each type of device installed, but not less than one of each type.

B. Notification Appliances: Provide a quantity equal to ten (10) percent of the number of each type (e.g. candela rating) of appliance installed, but not less than one of each type.

C. Detector Bases: Provide a quantity equal to two (2) percent of the number of each type installed, but not less than one (1) of each type.

D. Keys: Provide a minimum of five (5) keys of each type required. Keys and locks for all equipment shall be identical.

E. Lamps for Remote Indicating Lamp Units: Quantity equal to ten (10) percent of amount installed, but no less than 1 unit.

F. Lamps for Strobe Units: Quantity equal to ten (10) percent of amount installed, but no less than 1 unit.

G. Smoke Detectors, Heat Detectors, Projected Beam Detectors: Quantity equal to ten (10) percent of amount of each type installed, but no less than 1 unit of each type.

H. Detector Bases: Quantity equal to two (2) percent of amount of each type installed, but no less than 1 unit of each type.

I. Audible and Visual Notification Appliances: Quantity equal to ten (10) percent of amount of each type installed, but no less than one (1) unit of each type.

J. Keys and Tools: One (1) extra set for access to locked and tamper proofed components.

K. Fuses: Two (2) of each type installed in the system.

2.14 CONDUCTORS

A. Cable and conductors for any power limited circuits shall be type FPL, FPLP, or FPLR. When circuits are installed above a ceiling, conductors shall be type FPLP.

B. Cable and conductors for any non-power limited circuits shall be type NPLF, NPLFP, NPLFR or THHN installed in conduit. When circuits are installed above a ceiling, conductors shall be type NPLFP.

C. Where the size or type of conductor hereinafter specified conflicts with the FAEM's requirements, the larger size or more specialized conductor type will be used.

D. Cable and conductors for wet locations shall be as follows:

1. Types RHW, TW, THW, THHW, THWN, XHHW or other type listed for use in wet locations.
2. Type listed for direct burial.

E. All electrical characteristics (conductor-to-conductor capacitance, DC resistance, etc.) of the fire alarm Cable and conductors shall meet the requirements of the selected FAEM for the intended application.

F. All fire alarm Cable and conductors shall conform to the requirements of Article 760 of the National Electrical Code, and all local codes and standards.

G. All fire alarm cabling shall be permanently labeled with industry standard labels to clearly indicate the associated circuits. At a minimum, labels shall be provided at each junction box and as necessary to ensure the maximum distance of twenty (20) feet between labels. Handwritten labels are not acceptable.

2.15 RACEWAY

A. The following raceway types shall be permitted:

1. Non-continuous raceway (open air)
2. EMT conduit (3/4 inch minimum).
3. RIGID conduit (3/4 inch minimum).
4. Non-Metallic conduit for wet locations (3/4 inch minimum).
5. Surface mounted metallic raceway with a minimum size equivalent to three quarter (3/4) inch nominal conduit.
6. Other means as approved by Engineer or Owner's Representative.

B. All raceway types shall be new. Installing used raceway is unacceptable.

C. Using existing raceway is unacceptable without prior written permission of the Engineer or Owner's Representative.

D. Boxes, supports, and other accessories for the raceway installation shall be listed for the intended application.

2.16 CABLE MANAGEMENT WRAPS

A. Hook and Loop Cable Ties

1. Re-usable Velcro® strap for routing and securing cables and conductors.
2. Single piece strap with front side (hook material) that mates to its own rear side (loop material).

PART 3 - EXECUTION

3.1 COORDINATION WITH OTHER TRADES

A. Coordinate closely with all other trades to expedite construction, accurately interface with related systems, and avoid interferences.

3.2 INSTALLATION / APPLICATION

A. Furnish and install all control wiring, raceway, and outlet boxes for the fire alarm system.

B. Furnish and install all backboxes, equipment and devices for the fire alarm system.

1. Backboxes shall be of the exact type recommended by the FAEM as shown on the equipment and device submittals.
2. Backboxes shall be installed per the manufacturer's installation recommendations.
3. Devices and equipment must be installed by personnel legally permitted and currently licensed to install the devices and equipment. The cost of installation, warranty of installation and equipment, coordination of the installation, and supervision of the installation are responsibilities of the Contractor.

C. All fire alarm conduit, junction boxes, pull boxes, cable splices and terminal cabinets shall be accessible, painted red or clearly marked “Fire Alarm”. The Contractor shall comply with any local codes or AHJ requirements for circuit identification. Any access panels required for the accessibility to the junction boxes, pull boxes, cable splices and terminal cabinets shall be the responsibility of the Fire Alarm Contractor.

D. All cable and conductors not in conduit shall be installed in a neat and workmanlike manner utilizing a non-continuous pathway compliant with NEC requirements.

E. All conduit, cable and conductors shall be run at right angles (while maintaining manufacturers recommended bend radius specifications) to the building walls, floors, and ceilings. Connecting hardware shall be properly supported from the building structure at intervals compliant with NEC requirements.

F. All cable and conductors within fire alarm equipment enclosures shall be in the vertical or horizontal plane. Make all turns at right angles and tightly bundled and wrapped while maintaining manufacturers recommended bend radius specifications.

G. Cables and conductors shall be installed in a path that will provide proper spacing from electromagnetic interference in accordance with the NEC.

H. Identify all cable and conductors with permanent markings. Cable and conductor markings shall be printed labels, permanently affixed to the conductor via shrink wrap.

I. All power limited cable and conductors for the fire alarm system shall be installed in conduit in the following locations:

1. Seven (7) feet or less above the finished floor.
2. Below the structure.
3. Electrical and mechanical rooms (subject to physical damage).
4. Concealed above ceilings or in partitions (subject to physical damage).
5. Where required by applicable codes.
6. Cabling and conductors in finished areas that cannot be concealed are allowed to be installed in surface-mounted metallic raceway only upon approval of the Owner's Representative.
7. Where indicated on the engineering drawings.

J. All non-power limited cable and conductors for the fire alarm system shall be installed in conduit.

K. Power limited cable and conductors for the fire alarm system are not required to be installed in conduit in the following locations:

1. Above the structure / More than seven (7) feet above the finished floor.
2. Above lay-in ceilings.
3. Concealed in ceilings or partitions not subject to damage.

L. Exposed cable, conductors and conduits shall be concealed from public view at all locations by routing on the inside of joists, above lay-in ceilings, over girders, within partitions or in any other manner acceptable to the Owner's Representative.

M. Cable, conductors, and conduits installed above lay-in ceilings shall be supported from the building structure and shall not be permitted less than nine (9) inches above or behind removable panels or ceiling tiles.

N. Cables shall not rest directly on or be supported by ceiling panels, T-bars, ceiling support wires or any components of the suspended ceiling.

O. If support wires are necessary to properly support fire alarm cabling, independent support wires shall be attached to the building structure to carry the load and attached to the suspended ceiling grid to act as "sway control". When independent support wires are used, they must be distinguishable by color, tagging or other effective means.

P. Fire alarm cabling shall not be hung from any piping, ductwork or any hangers supporting piping or ductwork.

Q. Cables shall be installed utilizing a non-continuous pathway that must be attached to the building structure or walls with hardware specifically designed and listed to support the cable and its weight.

1. Hardware used to attach cable to structure shall be installed in a manor to ensure cable manufacturers recommended bend radius is maintained.

2. Non-continuous cable supports shall have flared edges to prevent damage to cable and conductors during installation.
3. Cables shall be installed such that the cable performance is not degraded or compromised.
4. Cable ties and wire straps shall not be used to attach cable to building structure where the cable ties or wire straps is bearing the weight of the cable.
5. Hardware used to attach cable to structure shall be engineered and designed for such purpose. Hardware shall be installed and utilized per manufacturer's specifications.
6. Cables shall not be installed in a manner such that the cable or conductors rest directly on building structure where damage to the cable may be caused by normal building movement and use.
7. Cable support hardware shall have a wide enough surface area of support to not affect the geometry or performance of the cable.
8. All cable and conductors not in conduit shall be supported from the building structure at intervals of no more than five (5) feet and ensure that midspan sag does not exceed 12 inches.

R. Cable management wraps shall be used to bundle and manage multiple fire alarm cables connected to the same system and sharing a common pathway.

S. Cable ties should be installed with the proper tension to not crimp or effect the geometry of the cable. The use of a Cable Tie tensioning tool is recommended.

1. Cable ties excess must be cut flush to remove any sharp edges that could cause harm to people, hardware, and connectivity.
2. Cable ties shall meet the appropriate listing for the environment in which they are installed.

T. Ground fire alarm control panel and associated circuits shall comply with IEEE 1100. Install a ground wire from main service ground to fire alarm control panel.

U. All cable and conductors shall be tagged at all junction points and shall test free from grounds or crosses between conductors.

V. All cable and conductors shall be pulled splice free. Cable and conductors shall be run continuous from device to device. The use of wire nuts, crimped connectors, or twisting of conductors is prohibited. All terminations shall be at a terminal strip utilizing screw terminals.

W. Cable and conductors that are terminated, spliced, or otherwise interrupted in any enclosure, cabinet, mounting, or junction box shall be connected to screw-type terminal blocks.

X. Power-limited wiring conductors shall not be installed in conduits with electric light, power Class 1, non-power-limited fire alarm and medium power network-powered broadband communications circuits.

Y. Final connections between equipment and the wiring system shall be made under direct supervision of a representative of the FAEM. If other personnel are required by the AHJ to be present during final connections, this shall not relieve the Contractor of the responsibility of providing a representative of the FAEM for direct supervision.

Z. Fire alarm cabling shall not be painted.

AA. Conduits shall enter the control panel enclosures only in the approved locations, as identified in the FAEM installation instructions.

BB. Existing systems being replaced, or their operations abandoned shall be removed immediately after the new fire alarm system is accepted by the Owner. All fire alarm equipment, equipment backboxes, accessible conduit and wiring shall be removed. Conduit and wiring that cannot be removed shall be marked "Abandoned". All fire alarm equipment (excluding backboxes, conduit, scrap wiring, and other equipment not strictly related to the demolished fire alarm system) shall be turned over to the Owner's Representative.

CC. When connecting to existing equipment, verify that existing fire alarm equipment is operational before making changes or connections.

1. Connect existing equipment to new control panel in existing part of the building.
2. Connect existing equipment to new monitoring equipment at the supervising station.
3. Expand, modify, and supplement existing equipment as necessary.
4. Existing components shall be capable of merging with new configuration without degrading the performance of either system.

3.3 EQUIPMENT INSTALLATION

A. Comply with NFPA 72 for installation of fire alarm equipment.

B. The control panels and auxiliary power supplies shall be surface mounted with no operational parts which may require maintenance mounted greater than seventy-two (72) inches above the finished floor. The control panel annunciator shall be mounted so that no switch, manually operated device, display or LED is greater than sixty (60) inches above the finished floor.

1. Installing the fire alarm control panels on concrete base the installation shall comply with requirements for concrete base."

    a. Install seismic bracing.
    b. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on eighteen (18) inch centers around the full perimeter of concrete base.
    c. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
    d. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
    e. Install anchor bolts to elevations required for proper attachment to supported equipment.

2. Comply with requirements for seismic-restraint devices.

C. The documentation cabinet shall be surface mounted as indicated on the engineering drawings.

D. Mount the cellular communicator within the enclosure at a location with acceptable signal strength from the wireless network connection. The cellular communicator shall not be installed above a suspended ceiling.

E. Duct detectors shall be mounted in the air duct of HVAC units as indicated on the engineering drawings. Duct detectors shall be mounted in such a way as to obtain a representative sample of the airstream. Detectors shall be accessible for cleaning and shall be mounted in accordance with the manufacturer's instructions and NFPA standards. Coordinate placement and connect all circuits. Install sampling tubes so they extend the full width of duct.

F. All HVAC equipment shutdown shall be initiated by relays . Relays shall be mounted within three (3) feet of the motor controller or control circuit of the affected equipment. Provide cabling and wiring connections to HVAC shutdown controls. Final terminations to HVAC shutdown controls are by mechanical or controls contractor. Provide any required intermediate relays for connections to HVAC shutdown controls.

G. Smoke and carbon monoxide detectors shall be mounted on the underside of the ceiling or deck. Locate detectors more than three (3) feet from air supply diffusers or return air openings. The smoke detector and fire alarm cabling shall be installed and supported a minimum 1 ½ inches from the lowest surface of the roof decking in accordance with National Electrical Code. Locate detectors not closer than one (1) foot from any part of a lighting fixture.

H. Where more than one single-/multi-station smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.

I. Smoke, carbon monoxide, heat, and duct detectors shall not be installed until after the construction clean-up of all trades is complete and final. Detectors that have been installed prior to final clean-up by all trades shall be cleaned or replaced in accordance with NFPA 72.

J. Manual pull stations shall be securely mounted with the operable part of the manual pull station no greater than forty-eight (48) inches above the finished floor and no less than forty-two (42) inches above the finished floor. Provide surface mounted on standard electrical boxes.

K. Wall mounted audible/visual, and visual appliances shall be surface mounted such that the entire lens is not less than eighty (80) inches and not greater than ninety-six (96) inches above the finished floor or at the mounting height specified using the performance-based alternative. Where low ceiling heights do not permit wall mounting at a minimum of eighty (80) inches, wall mounted appliances shall be mounted within six (6) inches of the ceiling.

L. Wall mounted visual appliances in accessible guest rooms shall be surface mounted on the wall greater than twenty-four (24) inches from the ceiling, within sixteen (16) feet of the pillow (measured horizontally), and in accordance with NFPA 72.

M. Ceiling mounted visual appliances in accessible guest rooms shall be surface mounted on the ceiling, rated at 177 candela, within sixteen (16) feet of the pillow (measured horizontally), and in accordance with NFPA 72.

N. Ceiling mounted audible/visual and visual appliances shall be mounted as shown on the engineering drawings with their visual lenses having an unobstructed line of site in all directions. Exact locations of appliances shall be sufficiently distant from vertical surfaces and hanging items to permit maximum viewing from all directions.

O. Devices and appliances shall be installed in the center or quarter point of the ceiling tiles. Devices and appliances shall not be supported by ceiling tiles. Devices and appliances must be attached to backbox supported by the ceiling grid.

P. All initiating devices and addressable modules shall be mounted in a location accessible for testing and maintenance.

Q. Provide a computer generated label for each initiating device indicating the specific address for that device. The label shall include the node number, loop number and device number where applicable. The label shall be located on the base of all detectors and the cover plates of addressable modules. Hand written labels are not acceptable.

R. Provide a computer generated label for each notification appliance indicating the circuit number, appliance number, and location of the end of line resistor. The label shall be located on the base of all notification appliances. Hand written labels are not acceptable.

3.4 CONNECTIONS

A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, connect hardware and devices to fire alarm system.

1. Verify that hardware and devices are NRTL listed for use with the fire alarm system in this Section before making connections.

B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than three (3) feet from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

1. Supervisory connections at valve supervisory switches.
2. Interface connections to door hold open devices.
3. Interface connections to kitchen hood suppression systems.
4. Interface connections to door contact monitoring panel.

C. Door hold-open devices that are controlled by smoke detectors at doors in smoke barrier walls shall be connected to the fire alarm system.

3.5 IDENTIFICATION

A. Comply with requirements for identification for system components, wiring, cabling, and terminals.

B. When required, install framed instructions in a location visible from the fire alarm control panel.

1. Instructions shall be computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

3.6 RESTORATION OF SITE

A. Where sidewalks, curbs, and lawns are excavated by the Fire Alarm Contractor, these areas shall be backfilled and replaced to the original condition and to the satisfaction of the Owner, Architect and AHJ.

3.7 PAINTING AND PATCHING

A. All fire alarm conduit shall be thoroughly cleaned, removing all dirt, oil, etc. and made ready to receive paint.

B. Holes in walls or floors cut during the performance of this work shall be patched or covered with standard escutcheon plates so as to completely conceal the cuts where they would otherwise be exposed to view.

C. Holes in walls and ceilings created by the removal of fire alarm equipment no longer used shall be patched and painted to match the existing walls and ceilings, or covered with standard escutcheon plates so as to completely conceal the "holes" where they would otherwise be exposed to view.

D. All penetrations of fire rated assemblies (wall or floor construction) shall be firestopped to preserve the original fire resistance and smoketight integrity of the assembly. All firestopping methods shall be UL listed Through Penetration Firestop Systems or otherwise approved by the Owner, Architect, Engineer, and AHJ. Specific firestop assembly shall be identified at the penetration location with a sticker or other approved identification means.

3.8 SYSTEM TESTS

A. All test and inspections specified in this section shall be reported in writing and submitted in accordance with this specification section.

B. The system shall meet all the requirements of the listed applicable codes and the requirements of the AHJ. The system tests and test documents, including those required for and by the approved remote monitoring station, shall meet the requirements of the AHJ.

C. Provide one hundred (100) percent initial acceptance testing of the entire fire alarm system prior to the required AHJ acceptance testing. Before requesting the AHJ acceptance testing, furnish a written statement to the Owner's Representative indicating that the system has been installed in accordance with the approved documents and tested in accordance with the manufacturer's specifications and the applicable NFPA requirements. The Record of Completion shall be completed and submitted as part of the written statement.

1. System tests shall be witnessed by Authorities Having Jurisdiction.
2. Manufacturer's factory-authorized service representative shall be engaged to inspect and adjust components, assemblies, and equipment installations, including connections, and to assist in testing.

D. All testing, inspection and retesting required for certification and required for all warranty work or replacements shall meet the requirements of the AHJ. This certification, inspection, or testing shall be completed at no additional cost to the Owner.

E. Provide the testing date in writing to the Owner a minimum of two (2) weeks before the date. The Owner may elect to have a representative present for testing.

F. The fire alarm system will not be acceptable until final testing and receipt of the testing certificates have been obtained.

G. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.

H. Testing and Inspections:

1. Visual Inspection shall be conducted prior to testing.

    a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
    b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

2. System Testing shall comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
5. Test visible appliances for the public operating mode according to manufacturer's written instructions.

I. Reacceptance Testing shall be performed to verify the proper operation of added or replaced devices and appliances.

J. Fire alarm system will be considered defective if it does not pass tests and inspections.

K. Maintenance Test and Inspection:

1. A proposal to perform annual testing and/or inspection services shall be submitted to the Owner a minimum of three (3) weeks before the date of initial acceptance testing. The proposal shall include all testing and/or inspection services required by the AHJ for the two (2) year period beginning at final acceptance of the system. The Owner has the option to accept or reject the proposal.
2. Maintenance Test and Inspection shall be performed as listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
3. Annual Test and Inspection shall be performed one (1) year after date of Substantial Completion. The fire alarm system shall comply with all visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.9 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain fire alarm system.

END OF SECTION 28 31 11

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. Section 015000 "Construction Facilities and Temporary 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.mo1call.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 Section 312000 "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. Section 015000 "Construction Facilities and Temporary 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 the Designer. Unauthorized excavation, as well as remedial work directed by the Designer, 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.

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.mo1call.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 Section 015000 "Construction Facilities and Temporary 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 the Designer.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by the Designer.

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 the Designer; 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 the Designer.

1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 312000

SECTION 321216 – ASPHALT PAVING

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.

B. Reference Standards: Missouri Department of Transportation Standard Specifications for Highway Construction (MoDOT Standard Specifications), latest edition.

1.2 SUMMARY

A. Section Includes:

1. Hot-mix asphalt patching.
2. Pavement-marking paint.

B. Related Sections:

1. Section 312000 "Earth Moving" for aggregate subbase and base courses and for aggregate pavement shoulders.

1.3 DEFINITION

A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.

1. Job-Mix Designs: For each job mix proposed for the Work.

B. Qualification Data: For qualified manufacturer and installer.

C. Material Certificates: For each paving material, from manufacturer.

D. Material Test Reports: For each paving material.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by the Missouri Department of Transportation.

B. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of the Missouri Department of Transportation and for asphalt paving work.

1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.

B. Store pavement-marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:

1. Prime Coat: Minimum surface temperature of 60 deg F.
2. Tack Coat: Minimum surface temperature of 60 deg F.
3. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.

B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 55 deg F for water-based materials, and not exceeding 95 deg F.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. General: Use materials and gradations that have performed satisfactorily in previous installations.

B. Coarse Aggregate: ASTM D 692, sound; angular crushed stone or crushed gravel.

C. Fine Aggregate: ASTM D 1073 or AASHTO M 29, sharp-edged natural sand or sand prepared from stone, gravel, or combinations thereof.

1. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.

D. Mineral Filler: ASTM D 242 or AASHTO M 17, rock or slag dust, hydraulic cement, or other inert material.

2.2 ASPHALT MATERIALS

A. Asphalt pavement will be designed according to:

1. Roadway: AASHTO Guidelines for Design of Pavement Structures, 1986
2. Parking Lot: The Asphalt Institute

B. Asphalt Binder: AASHTO M 320 or AASHTO MP 1a, PG 64-22.

C. Asphalt Cement: ASTM D 946 for penetration-graded material.

D. Prime Coat: ASTM D 2027, medium-curing cutback asphalt, MC-30 or MC-70.

E. Tack Coat: ASTM D 977 or AASHTO M 140 emulsified asphalt, or ASTM D 2397 or AASHTO M 208 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

2.3 AUXILIARY MATERIALS

A. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, Type II, with drying time of less than 45 minutes.

1. Color:
   a. White: Crosswalk
   b. Yellow: Centerline
   c. Blue: Accessible spaces and areas.

B. Glass Beads: AASHTO M 247, Type 1.

2.4 MIXES

A. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction and complying with the following requirements:

1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.

2. Surface Course: MoDOT Standard Type BP-2 Bituminous Pavement.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to begin paving.

B. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 PATCHING

A. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

B. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving at a rate of 0.05 to 0.15 gal./sq. yd.

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.

2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

C. Patching: Fill excavated pavements with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.

3.3 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

3.4 HOT-MIX ASPHALT PLACING

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

1. Place hot-mix asphalt surface course in single lift.

2. Spread mix at minimum temperature of 250 deg F.

3. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.

4. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.

1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of asphalt base course before placing asphalt surface course.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.5 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.

1. Clean contact surfaces and apply tack coat to joints.

2. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.

3. Compact asphalt at joints to a density within 2 percent of specified course density.

3.6 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction before mix temperature cools to 185 deg F.

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Average Density: 96 percent of reference laboratory density according to ASTM D 6927 or AASHTO T 245, but not less than 94 percent nor greater than 100 percent.

2. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent nor greater than 96 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.7 INSTALLATION TOLERANCES

A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:

1. Surface Course: Plus 1/4 inch, no minus.

B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:

1. Surface Course: 1/8 inch.

3.8 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with the Owner's Representative.

1. Replace pavement markings that were removed during construction operations.

2. Restripe parking spaces as indicated.

3. Coordinate with Owner's Representative on location of pavement markings.

B. Allow paving to age for 30 days before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

1. Broadcast glass beads uniformly into wet pavement markings at a rate of 6 lb/gal.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Engage qualified testing agency to perform tests and inspections.

B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.

C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

D. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D 979 or AASHTO T 168.

1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.

2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.

a. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than 3 cores taken.

b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.

E. Replace and compact hot-mix asphalt where core tests were taken.

F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.10 DISPOSAL

A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.

END OF SECTION 321216

SECTION 329200 – TURFS AND GRASSES

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 Work.

B. Work included in this Section includes clearing of weeds, seed bed preparation, installation of erosion control fabric and seeding operations required for seeding of the planted areas damaged by the performance of the work.

1.3 SPECIFICATIONS AND STANDARDS

A. U.S. Department of Agriculture: SRA 156 U.S. Department of Agriculture, Rules and Regulations under the Federal Seed Act.

B. American Joint Committee on Horticultural Nomenclature Standard: 1942 Edition Standardized Plant Names.

1.4 SUMBITTALS

A. Provide product data and certification sheets for seed, fertilizer and erosion control.

PART 2 - PRODUCTS

2.1 SEED

A. All seed shall be furnished in sealed, standard containers, unless otherwise approved. Seed which has become wet, moldy, or otherwise damaged will not be acceptable.

B. Each container of seed shall be fully labeled in accordance with the Federal Seed Act and seed certifications shall be signed and made part of seed invoices.

C. Seed shall be Fescue, 97 percent pure live seed

D. Invoices and tags for seed shall show type furnished. Upon acceptance of the seeded areas, a final check of total quantities of seed used will be made against total area seeded and if minimum rates of application or specified quantities have not been met, the Owner will require distribution of additional quantities of these materials to make up minimum application specified.

2.2 FERTILIZER

A. Fertilizer shall be uniform in composition, free-flowing, suitable for application with approved equipment and delivered to the site unopened in original containers each bearing the manufacturer’s guaranteed analysis and in conformity with state fertilizer laws. Fertilizer shall contain the following minimum percentage of plant food by weight.

1. 12 percent available nitrogen
2. 12 percent available phosphoric acid
3. 12 percent available potash

B. Fertilizer application rates shall be 600 pounds per acre.

C. Invoices for fertilizer shall show grade furnished. Upon acceptance of the seeded areas, a final check of total quantities of fertilizer used will be made against total area seeded and if minimum rates of application or specified quantities have not been met, the Owner will require distribution of additional quantities of these materials to make up minimum application specified.

2.3 EROSION CONTROL FABRIC

A. Fabric shall be "Soil Saver" as is distributed by Jim Walls Company in Dallas, Texas (214) 239-8577; or "Curlex Blankets" as is distributed by Americal Excelsior Company in North Kansas City, Missouri (816) 842-3034; or approved equal.

2.4 STAPLES

A. Staples shall be a No. 11 gauge steel wire formed into a "U" shape, 6 inches long.

PART 3 - EXECUTION

3.1 GROUND PREPARATION

A. General: All ground areas damaged by the Contractor are to be seeded and fertilized. Equipment necessary for the proper preparation of the ground surface and for handling and placing all required materials shall be on hand, in good condition and shall be approved before the Work is started.

B. Clearing: Prior to tillage, seeding or other specified operations, all vegetation which might interfere with the indicated treatment of the areas shall be mowed, grubbed, raked and the debris removed from the site. Prior to or during grading and tillage operations, the ground surface shall be cleared of materials which might hinder final operations. Areas which have been disturbed shall be finish graded and/or developed as indicated on the Drawings or as specified.

C. Tillage: After the areas required to be seeded have been brought to the finish grades as specified, they shall be thoroughly tilled to a depth of at least 6 inches by plowing, disking, harrowing or other approved methods until the condition of the soil is acceptable to the Construction Administrator. Work shall be performed only during period when beneficial results are likely to be obtained. When conditions are such by reason of drought, excessive moisture, or other factors that satisfactory results are not likely to be obtained, Work shall be stopped. Work shall be resumed only when desired results are likely to be obtained.

D. Leveling: Any undulations or irregularities in the surface resulting from tillage, fertilizing or other operations shall be leveled with a float drag before seeding operations are begun.

E. Fertilizing: Fertilizer shall be distributed uniformly at the rate previously specified per 1,000 square feet over the areas to be seeded and shall be incorporated into the soil to a depth of at least 3 to 4 inches by disking, harrowing or other approved methods. The incorporation of fertilizer may be a part of the tillage operation hereinbefore specified.

Distribution by means of an approved seed drill equipped to sow seed and distribute fertilizer at the same time will not be accepted. Fertilizer shall be incorporated into the soil a minimum of 10 days before seed is planted.

F. Inspection: A minimum of 48 hours prior notice must be given to the Construction Administrator before fertilizing may commence.

G. Planting Time: All seeding Work shall be done between the dates of April 1 to May 15 for spring planting and from August 15 to October 15 for fall planting except as otherwise directed in writing by the Construction Administrator.

H. Planting Condition: No planting shall be done until a permanent source of water is available at the site for use by the Owner.

3.2 SEEDING

A. General: Prior to seeding, any previously prepared seedbed areas compacted or damaged by interim rains, traffic, or other cause shall be reworked to restore the ground condition previously specified. Seed shall be planted by drill seeding.

B. Drill Seeding: Seed shall be uniformly drilled to an average depth of ½ inch and at the rate of 8 pounds per 1,000 square feet using equipment having drills not more than 6 ½ inches apart. Row markers shall be used with the drill seeder.

C. Rolling: Immediately after seeding, except for slopes 3 horizontal to 1 vertical and greater, the entire area shall be firmed with a roller not exceeding 90 pounds for each foot of roller width. Do not roll areas seeded with seed drills equipped with rollers.

D. Inspection: A minimum of 48 hours prior notice must be given to the Construction Administrator before seeding may commence.

3.3 INSTALLATION OF EROSION CONTROL FABRIC

A. Fabric shall be rolled out in place. Fabric shall be applied without stretching and shall lie smoothly but loosely on the soil surface. The Contractor shall refer to the Drawings for details of fabric fastening.

B. Application of the erosion control fabric shall occur the same day that the seeding of an area has taken place.

C. Fabric shall completely cover all areas which are shown on the Drawings to be protected from erosion. After fabric installation, the entire area shall be rolled with a smooth roller weighing between 200 to 250 pounds. After rolling, the fabric shall be in intimate contact with the soil surface at all points. Any clods, etc., which hold the fabric off the ground should be removed. The fabric shall be forced down into any depressions and held there with a staple.

3.4 MAINTENANCE

A. General: The project areas shall be kept clean at all times and care shall be taken that use of the premises shall not be unduly hampered by Work herein specified. The intent of this Section is to ensure a healthy, well-established turf, and prevent soil erosion in compliance with the land disturbance requirements of the Missouri Department of Natural Resources.

B. Responsibility: The Owner shall be responsible for maintenance of all seeded areas upon completion of seeding and general acceptance by the Construction Administrator.

C. Damage: Damage to seeded areas during the project shall be repaired by the persons responsible for causing such damage.

3.5 GENERAL ACCEPTANCE

A. The Construction Administrator shall make an inspection of the seeded areas upon completion of seeding. Seeded areas shall be considered acceptable if the specified quantities of fertilizer & seed have been properly applied.

3.6 GUARANTEE

A. The Contractor is responsible for the proper application of the fertilizer & seeding. Watering, weeding, re-seeding, and mowing will be the responsibility of the Owner after proper application of the seed.

END OF SECTION 329200

SECTION 337110 – MEDIUM-VOLTAGE OUTDOOR SECTIONALIZING CABINETS

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 medium-voltage outdoor sectionalizing cabinets as specified herein and as shown on the Drawings.

1.3 RELATED SECTIONS

A. Section 260500 – Basic Electrical Requirements

B. Section 260526 – Grounding and Bonding for Electrical Systems

C. Section 260529 – Hangers and Supports for Electrical Equipment

D. Section 260553 – Electrical Identification

E. Section 337149 – Medium-Voltage Wiring

1.4 SUBMITTALS

A. Product Data:

1. Submit manufacturer's data on sectionalizing cabinets including, but not limited to, service voltages, number of phases and number of junctions.

2. Provide manufacturer’s product data sheets on junctions indicating voltage and amperage ratings and whether load break or dead break rated.

3. Provide manufacturer’s product data sheets for stand-off parking bushings indicating voltage and amperage ratings.

4. Surge arresters

B. Shop Drawings: Submit plan view and elevation view outline drawings of sectionalizing cabinets showing dimensions, arrangements, electrical ratings, components, weights, dimensioned locations, and sizes of anchor bolt holes in base, sheet metal gauge and finish color.

C. Certification of Ratings: Furnish certification of ratings of the basic switch and fuse components and/or the integrated pad-mounted switchgear assembly consisting of the switch and fuse components in combination with the enclosure. Certification of the integrated unit shall include testing the pad-mounted switchgear to the fault-close requirements of the specification to assure the bus support system and components are adequate.

1.5 APPLICABLE STANDARDS

A. ANSI/IEEE C57.12.28 – 2014 – IEEE Standard for Pad-Mounted Equipment Enclosure Integrity

B. ANSI/IEEE C57.12.38 – 2014 – IEEE Standard for Pad-Mounted Type, Self-Cooled, Single-Phase Distribution (Parking Stands Only)

C. IEEE386 – 2006 – IEEE Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V.

D. NEMA LA 1 – Surge Arresters

1.6 QUALITY ASSURANCE

A. ANSI/IEEE Compliance: Comply with applicable requirements of all applicable ANSI/IEEE standards, including C57.12.28 – Pad-Mounted Equipment Enclosure Integrity covering enclosure integrity for pad-mounted equipment.

B. Sectionalizing cabinets shall be UL Listed and Labeled.

1.7 EXTRA MATERIALS

A. Provide one (1) 12-ounce, minimum, aerosol can each of red-oxide primer and the Munsell 7GY3.29/1.5 topcoat paint for touching up scratches in the sectionalizing enclosure paint finish.

B. Provide three (3) spare elbow type surge arresters.

PART 2 - PRODUCTS

2.1 CONSTRUCTION

A. The sectionalizing cabinet enclosure must be continuous seam-welded and manufactured of 12-gauge HRPO mild steel.

B. All hardware must be stainless steel for corrosion resistance.

C. Enclosure finish color shall be Munsell Green 7GY 3.29-1.5 and must meet the finish requirements as defined in IEEE Standard C57.12.28.

D. Enclosure must include a top hinged removable cover and allow one person operation. The cover must also include a wind stop to prevent accidental closing.

E. Enclosure must include a deep angled recessed door with low sill for easy accessibility.

F. Enclosure must include 12.5° angled universal mounting plates painted light grey for optimum visibility of cable terminations and must accept three (3) 200A, 15kV, loadbreak junctions with U-straps.

G. Enclosure size shall be 30” high by 22” to 23” deep by 66” wide.

H. Enclosures must be available with the 15kV, 200A loadbreak junctions installed.

I. Enclosure must include “parking lot” parking stand design providing multiple options for parking of accessories and providing rigidity to the back of the enclosure to prevent oil-canning during operation.

J. Enclosure must provide a minimum of one (1) parking stand pocket per phase.

K. Enclosure must include a minimum of one (1) grounding provision per phase and a 3/8” copper ground rod installed inside the enclosure.

L. Enclosure must include provisions for lifting.

M. Enclosure must include a recessed lock pocket, padlock hasp and pentahead bolt for security.

2.2 LABELING

A. The enclosure door shall be provided with “Warning – High Voltage – Keep Out” or "Warning-Keep Out-Hazardous Voltage Inside-Can Shock, Burn, or Cause Death" signs.

B. The outside of the door shall be provided with a nameplate indicating the manufacturer's name, catalog number, model number, date of manufacture and serial number.

C. A label from a National Recognized Testing Laboratory (NRTL) indicating the equipment is UL listed shall be applied to the inside of the sectionalizing cabinet in a readily visible location.

2.3 APPROVED MANUFACTURERS

A. Medium-voltage outdoor sectionalizing cabinets shall be as manufactured by:

1. Eaton Cooper Power SecTER Cabinet (basis of design)
2. Designer approved equal by Hubbell Power Systems, Inc. or nVent Hoffman

2.4 INSULATED STANDOFF PARKING BUSHINGS

A. Furnish three (3) portable, insulated, 200A standoff parking bushings for storage of a disengaged 200A load-break elbow inside the sectionalizing cabinet enclosure.

B. Insulated standoff parking bushings shall meet the full requirements of ANSI/IEEE Standard 386 – Separable, Insulated Connector Systems.

C. Insulated standoff parking bushings shall be designed to be installed in the parking bracket located in the switchgear cable termination compartments.

D. A grounding lug shall be provided on each standoff parking bushing bracket for attachment of a grounding wire to ensure dead-front construction.

E. Each 200A standoff parking bushing shall have a molded EPDM rubber body, stainless steel eyebolt with a brass pressure foot and stainless steel or cast aluminum base bracket. The EPDM rubber body shall be bolted to the base bracket using a galvanized steel hold-down ring.

F. 200A, 15 kV Class insulated standoff parking bushings shall meet the following requirements:

1. Standard Voltage Class ..... 15 kV
2. Maximum Rating, Phase-to-Phase ..... 14.4 kV
3. Maximum Rating, Phase-to-Ground ..... 8.3 kV
4. AC, 60 Hz, 1 Minute Withstand ..... 34 kV
5. DC, 15 Minute Withstand ..... 53 kV
6. BIL and Full Wave Crest ..... 95 kV
7. Minimum Corona Voltage Level ..... 11 kV
8. Continuous and Load Break Current Rating 200A
9. 10 Cycle Momentary & Fault Close ..... 10kA Symmetrical

G. Insulated standoff parking bushings shall be manufactured by Eaton-Cooper, Elastimold, Raychem or 3M.

2.5 SURGE ARRESTERS

A. Each sectionalizing cabinet shall include three (3) 9 kV duty cycle voltage rated, 7.65 MCOV, load break elbow, plug in, MOV type surge arresters, with braided copper ground conductor. One surge arrester for each primary phase.

B. Surge arresters shall be distribution class and shall comply with NEMA Standard LA 1.

C. Surge arresters shall be Eaton-Cooper Type M.O.V.E or approved equal by Elastimold or Hubbell Power Systems.

D. Three (3) spare surge arresters shall be furnished and provided to the Construction Representative.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The Contractor shall install all equipment per the manufacturer's written instructions and as indicated in the detail on Drawing E-501.

B. Touch up all blemishes in factory finish on the equipment using the method recommended by the equipment manufacturer and using primer and touch-up paint provided by the equipment manufacturer.

3.2 SURGE ARRESTERS

A. Connect the specified elbow type surge arresters to the third 200-ampere load-break bushing insert module on each phase and connect the ground cable of each arrester to the existing grounding rod in the fiber glass box pad beneath each sectionalizing cabinet.

3.3 ADJUSTING AND CLEANING

A. Upon completion of installation, inspect interiors and exteriors of accessible components. Remove paint splatters and other spots, dirt, and construction debris. Touch up scratches and mars of finish to match original finish using manufacturer supplied touch up paint.

END OF SECTION 337110

SECTION 337119.13 – ELECTRICAL UNDERGROUND DUCTS

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. The Contractor shall furnish and install all electrical underground ducts and duct banks as specified herein and as shown on the Drawings.

B. The Contractor shall furnish and install underground junction boxes, control conduit and pull tape for installation for the MU Energy Management control system fiber optic network as specified herein and as shown on the Drawings.

1.3 RELATED SECTIONS

A. Section 032000 – Concrete Reinforcing

B. Section 033000 – Cast-In-Place Concrete

C. Section 260500 – Common Work Results for Electrical

D. Section 260526 – Grounding and Bonding

E. 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, Schedule 40 PVC, DB-60 PVC)
2. Fiberglass long radius elbows
3. Intumescent silicone sealant
4. Protective coating for direct buried metal conduit
5. Underground conduit warning tape
6. Conduit pull tape
7. Conduit/duct plugs
8. Conduit spacers for conduit duct banks
9. Red cement coloring dye for concrete encased 12.47 kV conduit duct banks

1.5 QUALITY ASSURANCE

A. All material and equipment must be new and must be UL listed and labeled.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect stored conduit from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing indoors.

B. Store plastic conduit protected from direct sunlight. Support to prevent sagging and bending.

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 of the Federal Specifications WW-C-581d, ANSI Standard C80.1, and UL Standard No. 6.

    a. GRC shall be used below grade as specified herein and as shown on the Drawings.

2. Rigid non-metallic conduit shall be heavy wall Schedule 40 (NEMA EPC-40 PVC, Type II-III) polyvinyl chloride (PVC) electrical plastic conduit. All fittings shall be cemented using an approved PVC solvent cement. Rigid non-metallic conduit shall be as manufactured by Carlon Electrical Products; Condux International, Inc.; Can-Tex Industries; Certainteed Products Corp.; or approved equal.

3. Type DB-60 polyvinyl chloride (PVC) conduit, designed for use in concrete encasement applications, rated for 90°C cable and meeting NEMA Standard TC-6 and ASTM F-512 for underground applications may be used in lieu of Schedule 40 PVC conduit. Type DB-60 conduit shall be as manufactured by Carlon Electrical Products, Condux International, Inc., Certainteed Products Corp. or Can-Tex Industries.

4. Fiberglass long radius elbows shall be provided for 12.47 kV duct banks and shall be 48” minimum radius for horizontal bends and 36” minimum radius for vertical bends.

2.2 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 approved equal.

B. Fire barrier packing material for use with 3M UL listed 3000WT intumescent silicone sealant shall be 3M Fire Barrier Packing Material PM4 or mineral wool.

2.3 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.

2.4 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 electric duct banks and all directly buried electrical conduits 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 tape 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.

2.5 CONDUIT PULL TAPE

A. Low-stretch polyester flat, woven tape with minimum 2500 lb. rating.

B. Rot and mildew resistant.

C. Permanently printed sequential measurements at one-foot increments.

D. Pull tape shall be Neptco Muletape WP2500P or approved equal.

2.6 CONDUIT/DUCT PLUGS

A. Plugs for sealing empty underground conduits and ducts in manholes, handholes and at entry to floor mounted and outdoor pad-mounted equipment 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 shall be 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.

2.7 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.

2.8 CONCRETE ENCASEMENT

A. ADMIXTURES

1. Air-entraining mixture shall be used for all exterior concrete and shall conform to ASTM C260. The total calculated air content by volume as determined by ASTM C231 shall be as follows:

Maximum Course Aggregate Size	Total Air Content, % (Includes Trapped Air)
3/4"	3-8
1”	4-6

2. Water reducing admixture shall be used to reduce the total water requirements of ASTM C494, Type A.
3. Calcium chloride or accelerating admixtures containing calcium chloride shall not be used.

B. PROPORTIONING

1. Concrete slump at the time of placement as determined by ASTM C13 shall be 3” or 4”. Tolerance up to 1” above maximum will be allowed providing average batches tested does not exceed maximum.
2. The minimum 28 day concrete compressive strength for concrete shall be 4,000 psi (6 sacks/cu yd minimum).

C. REINFORCEMENT

1. All concrete encased electrical conduit duct banks shall contain steel reinforcing throughout the entire length as indicated in the standard details on the Drawings. The minimum size of reinforcing steel shall be size No. 4.

D. BACKFILL

1. Backfill material shall be compacted satisfactory soil in accordance with Specification 312000 – Earth Moving or ¾” minus waste rock fill. No concrete or large rocks are to be used.

E. 12.47 kV DUCT BANK CONCRETE COLOR ADDITIVE

1. The concrete for all concrete encased 12.47 kV duct banks shall have a medium color additive with a minimum concentration per the manufacturer’s recommendation per yard of concrete.

PART 3 - EXECUTION

3.1 INSTALLATION

A. 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 hereinafter specified 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 workmen and the public during the construction. Provide temporary supports for all underground utilities crossing an excavation.
4. Conduit in trenches shall be supported throughout the entire length on solid earth.
5. Underground conduit shall be rigid galvanized steel for a minimum of eight (8) feet from building walls at all penetrations. PVC conduit shall not be used at penetrations.
6. All metallic conduit directly buried in earth shall be factory PVC coated with field applied PVC coating at joints or 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.

7. Backfill for trenches containing direct buried conduit shall be in accordance with Division 31 – Earthwork. Any settlement shall be corrected by refilling and retamping. No puddling will be permitted.
8. Underground conduits shall be at least 12 inches away from gas, water, steam or other pipe lines and steam tunnels, chases or manholes.
9. Individual direct buried 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 underground conduits in sizes 2 inches and larger shall be fiberglass.
11. Couplings for conduits in a common trench shall be staggered at least 6 inches. All joints shall have watertight seals.
12. Install PVC bell end fittings at each PVC conduit termination. Bell fittings shall be grouted flush with the inside surface of the handhole wall.
13. All PVC conduit joints shall be sealed using the adhesive joint solvent cement recommended by the manufacturer of the PVC conduit to prevent conduit joints from separating during construction and pulling in cable.
14. All PVC conduit couplings and end bells shall be properly glued to the conduit, pushing the conduit all the way in to the stop on the coupling/end bell.
15. Upon completion of the conduit installation, Contractor shall swab out conduits to remove any rocks and debris. Swabbing shall be conducted with Owner's Representative present. Owner's Representative shall be notified a minimum of 24 hours prior to swabbing.
16. All conduits shall have a polyester pull tape, as specified herein, installed for future use. Pull tape shall have permanently printed sequential measurements at one-foot increments. Wire shall not be used.
17. Provide 10' of spare length of pull tape at both ends and terminate on conduit/duct plug inside junction boxes, handholes and manholes.

B. ELECTRICAL CONDUIT DUCT BANKS

1. Underground concrete encased 12.47 kV electrical conduit duct banks shall consist of either Schedule 40 or Type DB-60 polyvinyl chloride (PVC) conduit encased in reinforced concrete, providing an underground connection of raceways as shown on the Drawings.
2. All other conduit duct banks, whether indicated on the Drawings to be encased in non-dyed concrete or to be installed without concrete encasement shall be Schedule 40 PVC conduit.
3. The size and quantity of all electrical duct bank conduit shall be as indicated on the Drawings.
4. Conduits shall have long sweep elbows, 48" minimum radius for horizontal bends and 36" minimum radius for vertical bends. Factory elbows for conduit sizes 2 inches and larger shall be fiberglass.
5. Couplings for conduits in a conduit duct bank shall be staggered at least 6 inches. All joints shall have watertight seals.
6. Install PVC bell end fittings at each PVC conduit termination. Bell fittings shall be grouted flush with the inside surface of the handhole wall.
7. All PVC conduit joints shall be sealed using the adhesive joint solvent cement recommended by the manufacturer of the PVC conduit to prevent conduit joints from separating during construction and pulling in cable.

8. All PVC conduit couplings and end bells shall be properly glued to the conduit, pushing the conduit all the way in to the stop on the coupling/end bell.
9. Underground electrical conduit duct banks shall be installed a minimum of 36 inches below finish grade to the top surface of the duct bank, unless otherwise indicated.
10. The duct bank conduit shall be rigid galvanized steel in all locations subject to vehicular traffic where the depth of the duct bank is less than 36 inches below finish grade to the top surface of the duct bank or as indicated on the Drawings.
11. Underground electrical conduit duct banks shall be at least 12 inches away from all other underground utilities; gas, water, steam, telephone, communications, etc., and at least 36 inches away from steam pipe lines and steam tunnels, chases or manholes.
12. Conduits shall be installed with minimum slope of 1/2% toward manholes or other drainage point as shown on the Drawings.
13. The maximum change in direction in any plane between lengths of straight rigid conduit without the use of bends shall be limited to 5 degrees.
14. Each underground conduit in concrete encased duct banks shall have a minimum of 3 inches and a maximum of 6 inches of concrete around it in all directions.
15. Intermediate and base spacers shall be used to obtain uniform separation and alignment during the installation of the concrete. Maximum intervals between spacers shall be 8 feet.
16. Upon completion of the installation of the duct bank demonstrate to the Owner's Representative that all conduits are clear of obstructions by pulling a mandrel 1/2-inch smaller than the nominal size of the conduit through the entire length of each conduit.
17. All conduits shall have a polyester pull tape, as specified herein, installed for future use. Pull tape shall have permanently printed sequential measurements at one-foot increments. Wire shall not be used.
18. Provide 10' of spare length of pull tape at both ends and terminate on conduit/duct plug inside junction boxes, handholes and manholes.

C. INTUMESCENT SILICONE SEALANT

1. Seal all around the cables or conductors inside all conduits and ducts entering handholes, underground junction boxes and outdoor pad mounted equipment with intumescent silicone sealant to prevent entry of water, vermin, or debris in the conduit.
2. Use 3M Fire Barrier Packing Material PM4 or mineral wool as backing material within the conduit.
3. Install in accordance with the manufacturer's instructions.

D. 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 or a building through the conduit.
2. Size plugs based on the trade size of the conduit/duct to be sealed.
3. Tie-off pull tape 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.

E. UNDERGROUND CONDUIT WARNING TAPE

1. Unless otherwise indicated, the location of all underground electrical conduit duct banks and all directly buried conduits shall be marked by burying one or more warning tapes below grade in the backfill. The warning tape 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.

3.2 ELECTRICAL CONDUIT DUCT BANK EARTHWORK

A. Earthwork shall comply with Division 31 – Earthwork.

B. Conduit 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, FORMWORK AND REINFORCEMENT

A. All concrete, formwork and reinforcement shall be in accordance with Division 03 – Concrete.

B. Concrete encased electrical conduit duct banks shall contain steel reinforcing throughout the entire length as indicated on the standard details on the Drawings.

C. The minimum size of reinforcing steel shall be size No. 4. The reinforcing steel shall be installed longitudinally, at each corner of the duct bank (in cross section) and along the top, bottom and sides at a maximum of 12 inches on center. All reinforcing steel shall have a minimum concrete cover of 1-1/2 inches. Reinforcing shall be installed latitudinally, as needed, to hold the longitudinal steel in place during placement of the concrete, but not more than 48 inches apart.

D. In no case shall duct bank sidewall thickness exceed 12 inches from the side of the duct.

E. The concrete for all 12.47 kV duct banks shall have medium red color additive. The color additive shall have a minimum concentration per manufacturer’s recommendation per yard of concrete and 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.

F. Concrete shall be placed with the aid of a mechanical vibrator.

G. 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, except for high-early-strength concrete, which shall be three (3) days minimum.

3.4 UNDERGROUND UTILITIES

A. 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.

B. Before any excavations are begun, the Contractor shall communicate with the Owner and obtain, if possible, the exact location of any privately underground structures or utilities located in the vicinity of the excavation.

C. Existing underground utilities shown on the Drawings are based on available record documents obtained from the Owner, but their accuracy is generally unconfirmed. Existing underground utilities in the areas of construction are believed to be private and therefore, will not be located by the Missouri One Call program. Obtain field utility locates from a private utility locate company prior to performing any excavation work.

D. 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.

E. 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.

F. All conduit, water, gas, and sewer pipes adjacent to or crossing excavations shall be properly supported and protected by the Contractor.

END OF SECTION 337119.13

SECTION 337149 – MEDIUM-VOLTAGE WIRING

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. 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 260553 – Identification for Electrical Systems

D. Section 337119.13 – Electrical Underground Ducts

1.4 SUBMITTALS

A. Manufacturer's product data sheets shall be submitted for each of the following items:

1. Medium-voltage power cable
2. Medium-voltage cable termination kits
3. Medium-voltage cable splice kits
4. Medium-voltage cable arc-proofing tapes
5. Medium-voltage cable moisture seals

B. Submit qualification data for medium-voltage cable splice and termination installer certifying adequate training and experience for the specific type of splice and termination required for this project.

C. Submit qualification data for medium-voltage cable DC HiPot testing technician certifying adequate training and experience for the successful performance of the testing required.

D. Submit 15 kV cable preparatory test report prior to commencement of medium-voltage cable testing.

E. Submit 15 kV cable acceptance test report.

PART 2 - PRODUCTS

2.1 GENERAL

A. All applicable requirements of 2023 National Electrical Code (NEC) Article 305 – General Requirements for Wiring Methods and Materials for Systems Rated Over 1000 Volts ac, 1500

Volts dc, Nominal and Article 315 - Medium Voltage Conductors, Cable, Joints, and Cable Terminations 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 and terminations shall be insulated and rated for 15 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 15 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: Class B compact stranded per ASTM B-496, uncoated annealed copper per ICEA S-93-639/NEMA WC 74 Section 2, size 2 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, ICEA S-97-682, AIEC CS8 and UL 1072. 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 220 mils for 133% insulation level per ICEA S-93-639/NEMA WC 74 Table 8-3. 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, ICEA S-97-682, AIEC CS8 and UL 1072. The insulation shield shall not contain any polyethylene.
5. Shield: Bare uncoated 5 mil thick, or overlapped 3 mil thick, copper tape helically applied over the insulation shield with a 25% 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. 80 mils: 2 AWG to 500 KCM

7. Temperature Rating, Continuous Use:

    a. 105°C normal operation, wet or dry locations
    b. 140°C emergency overload
    c. 250°C short circuit conditions

8. Testing: All cables shall be flat line corona tested with less than 5 picocoulombs by cable manufacturer in accordance with the applicable requirements of ICEA S-93-639/NEMA WC 74, AEIC CS8, UL 1072 and IEEE 383.
9. Certification: All cables shall be certified to be in conformance with all applicable requirements of ICEA S-93-639/NEMA WC 74, ICEA S-97-682, AEIC CS8, UL 1072 and IEEE 383.

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 or Kerite – No substitutions allowed.

2.3 MEDIUM-VOLTAGE CABLE SPLICE AND TERMINATION KITS

A. Splices for EPR insulated cables shall be made using copper compression connectors, in watertight splice fittings which shall be either compound filled or power cable joint type.

B. Splice fittings shall be copper compression type, as manufactured by the splicing kit manufacturer; Burndy, Hubbell-Anderson/Fargo, 3M Company or approved equal.

C. All splice kits for the 15 kV, #2 Type MV-105 cable specified herein shall be cold shrink type 3M 5513A QS-III Series Splice Kit as manufactured by 3M Company, or approved equal by Elastimold or Raychem Corporation.

D. Cable end terminations at medium-voltage pad-mount switchgear and dry-type, medium-voltage transformers 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.

E. Such terminations shall also include stress cones and cable stress relief. All termination kits for the 15 kV, #2 Type MV-105 cable specified herein shall be rated Class 1 (IEEE 48, latest edition) and shall be cold shrink type 3M 7622-S-2 QT-III Series silicone rubber termination kit, as manufactured by 3M Company or approved equal by Elastimold or Raychem Corporation.

F. Cable end terminations at pad-mounted, liquid-filled, medium-voltage transformers and medium-voltage outdoor sectionalizing cabinets shall be 200A load-break elbow type and shall have a hot-stick stainless steel reinforced pulling eye for easy removal of the connector from mating connector, a load break contact with arc follower, a rubber locking ring to firmly seat and lock in place the male contact, a built-in, factory tested, molded stress relief for proper termination of the 15 kV shielded cable, a molded conductive connector shield, a grounding eye for external connection to ground of the cable and connector shields, a capacitive test point and a metallic shield adapter for shield grounding. Connectors shall be of quick-make, quick-break design.

G. Load-break elbow connectors shall be rated for 200 amperes RMS continuous operation, 14.4 kV maximum across the contacts during the switching operation (load-make, load-break, or fault close), 95 kV BIL, 11 kV minimum corona voltage level, withstand 34 kV 60 Hz for one minute and 53 kV DC for 15 minutes, 200 amperes RMS continuous, and 10,000 amperes RMS symmetrical fault close at 14.4 kV (0.17 second), 10,000 amperes RMS symmetrical short time (0.17 second) and 3,500 amperes RMS symmetrical short time (3.0 seconds); 3M 5810 Series or approved equal by Eaton-Cooper, Elastimold or Hubbell Power Systems.

H. Load-break elbow connectors must be compatible with the bushing insert modules on the pad-mounted distribution transformer specified in Section 261219 – Pad-Mounted, Liquid-Filled Medium-Voltage Transformers and Section 337110 – Medium-Voltage Outdoor Sectionalizing Cabinets.

2.4 MEDIUM-VOLTAGE 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^2. 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-Volitle 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 MEDIUM-VOLTAGE CABLE ARC-PROOFING TAPES

A. *Arc-Proofing Tape*: 3M Scotch 77W (light gray), 30 mils thick, 1.5 inch or 3-inch-wide, non-adhesive

B. *Glass Cloth Tape*: 3M Scotch 69, 7 mils thick, 3/4-inch-wide with high-temperature thermosetting silicone adhesive

C. *Insulating Tape*: 3M Scotchrap 50, 10 mils thick, 2-inch wide

2.6 MEDIUM-VOLTAGE 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.

PART 3 - EXECUTION

3.1 CABLE INSTALLATION

A. 15kV cables shall be installed in existing and new underground ducts, cable vaults, manholes and handholes and into new pad-mounted, liquid-filled, medium-voltage transformer, new medium-voltage outdoor sectionalizing cabinets and existing and new medium-voltage pad-mounted switchgear.

B. All cable ends shall be kept sealed 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 prior to installation and immediately following installation until splices or terminations are made.

C. Examine duct, cable vault, manhole and handhole for cleanliness of duct, 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 ducts, cable vault, manhole, handhole and medium-voltage equipment wiring compartment 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 the 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.

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 cable moisture seals, as specified herein in, to prevent moisture in duct from infiltrating the cable jacket and insulation. Do not pull cables with ends unsealed. Before and after pulling, the cable end seal on each cable shall be examined and replaced if necessary. All cut cable ends shall be promptly sealed after cutting, except those to be spliced or terminated immediately after cutting.

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 the need for 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 conduit 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. Arrange cables in cable vault, manhole and handhole in a manner so unused ducts remain unobstructed and clear for installation of future cables. Cables shall be neatly trained around the walls of manhole and handhole utilizing cable support racks. Cables running across the middle of manhole/handhole, under the manhole or handhole access openings, or that droop onto the floor, will not be accepted.

U. The grounding conductor associated with each set of medium-voltage cables shall be exothermically welded to the grounding rod inside each cable vault, manhole or handhole, and shall be bonded to the cable support bushing and/or conduit grounding bushing inside medium-voltage equipment wiring compartment and shall be connected to the ground pad, ground bus or ground lug inside medium-voltage equipment wiring compartment.

3.2 CABLE SPLICE AND TERMINATION INSTALLATION

A. Unless the Contractor's cable splice and termination installer has first-hand experience with installation of the exact type of splice and termination kits required for this project, the manufacturer of the splice and termination kit equipment shall field instruct the Contractor's personnel on creating a satisfactory splice and termination by demonstration of at least one cable splice and one cable termination, of each different type used on this project, in the presence of the Designer and/or Construction Representative.

B. Cable splices and terminations shall only be performed by personnel trained and experienced in the installation of the materials specified herein. Submit the qualifications of cable splice and termination installer for review prior to commencement of any work in the field.

C. It shall be this Contractor's responsibility to furnish, deliver and install the exact size and type of connection necessary for each particular splice and termination.

D. Install splices at pull points, such as at manholes and handholes and elsewhere as shown on the Drawings.

E. All splices and terminations shall be made using kits specifically designed for the particular application. The splice or terminating kit manufacturer's instructions for performing the work shall be strictly followed.

F. All splicing and terminating 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. Stress cones or 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 cables at all terminations and splices. Ground metal bodies of terminations, splices, cable connector fittings and hardware in accordance with the manufacturer's written instructions.

I. The electrical continuity of the cable shield shall be ensured at each cable splice. Cable shields shall be grounded at each cable splice unless otherwise indicated.

3.3 CABLE ARC-PROOFING

A. Apply arc-proofing tape to the entire exposed length of all medium-voltage power cables which have been spliced in a cable vault, manhole or handhole per the arc-proofing tape manufacturer's written instructions after installation of the specified type of splice kits and successful completion of DC HiPot testing.

B. Cables shall be cleaned of all oil, grease and cable pulling compounds using suitable cleaners and solvents that are non-injurious to the cable and then wiped completely dry.

C. The cables shall be trained as closely as possible to their final positions.

D. Where in-line cold shrink type splice kits are used, bundle the three (3) cables of each circuit together and wrap arc-proofing tape around the three-conductor bundle rather than around each individual cable extending the arc-proofing tape over the splice kits themselves. The equipment grounding conductor is not to be wrapped with arc-proofing tape.

E. If required, any projecting surfaces such as fittings, ground or bonding connections shall be covered with insulating compound or wrapped with one half-lapped layer of 2-inch-wide insulating tape, to present a smooth continuous surface for arc-proof taping.

F. One half-lapped layer of arc-proofing tape shall then be applied over the full exposed length of the exposed portion of the three (3) cable bundle, and into the duct, on both sides of the cable vault, manhole or handhole, at least 1.5 inches. Tape shall be wrapped as tightly as possible to obtain a snug, wrinkle-free wrap which conforms to the cable and splice, where in-line cold shrink splice kits are used. Additional overlapping shall be applied wherever required, such as on curved sections of the cable and around projections. Overlap the last 6 inches of protected cable when starting a new roll of tape.

G. The arc-proofing tape is not adhesive coated and shall be held in place after wrapping by banding the first and last applied wrap of arc-proofing tape with two (2) complete wraps of adhesive glass cloth tape. Do not spiral wrap or random reverse wrap the glass cloth tape over the arc-proofing tape as this will interfere with the foaming (intumescent) protective action of the arc-proofing tape which will expand in the event of a fire within the manhole to provide an insulating firewall between the flames and cables.

3.4 MEDIUM-VOLTAGE POWER CABLE IDENTIFICATION

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

3.5 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 of all preparatory testing to Engineer indicating date of testing, name(s) and employer of individual(s) performing 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 assure 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 (surge) arresters and capacitors, if used, must be disconnected during testing.

G. Acceptable independent cable acceptance testing firms shall be:

1. ABB Services
   Kansas City, KS
   (913) 286-8028
   Roger Andrews
2. Eaton Engineering Services and Systems
   62 Soccer Park Rd.
   Fenton, MO 63026
   (314) 374-6190
   Tom Bush
1. Schneider Electric Services
   St. Louis, MO
   (314) 437-6987
   Andrea Wolfe

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 5,000-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 55,000 volts for new 15 kV cable and 30,000 volts for existing 15 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 done 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. Where new cables are spliced to existing cables the entire spliced cable shall be tested as an existing cable at 30,000 VDC held for 10 minutes.

O. 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.

P. 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 for new cable or 10 minutes for existing cable. Any subsequent increase of current during this test is indicative of a bad cable or equipment and the test should be stopped, and further instructions obtained from the Designer.

Q. 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 3 kV shall be recorded. With the voltage at zero, the cable shall be connected to ground and then disconnected from the test equipment.

R. Each cable shall be tested between one conductor and ground with the other two conductors, metallic shielding and the metal sheath connected to ground.

S. 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.

T. 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.

U. 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, cable shields grounded at the termination, and in-line splices arc-proof taped as specified herein.

END OF SECTION 337149

SECTION 337710 – MEDIUM-VOLTAGE PAD-MOUNTED SWITCHGEAR

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 medium-voltage, air-insulated, dead-front, manually operated, pad-mounted switchgear assemblies as specified herein and as shown on the Drawings.

1.3 RELATED SECTIONS

A. Section 260500 – Basic Electrical Requirements

B. Section 260526 – Grounding and Bonding for Electrical Systems

C. Section 260529 – Hangers and Supports for Electrical Equipment

D. Section 260553 – Electrical Identification

E. Section 260573 – Protective Device Coordination Study and Arc Flash Risk Assessment

F. Section 337149 – Medium Voltage Wiring

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's data on switchgear including, but not limited to, service voltages, number of phases, frequency, main bus current ratings and interrupting capacities, and switch and fuses types and ratings. Provide product data sheets for medium-voltage fuse holders and fuses, including time current characteristic trip curves.

B. Shop Drawings: Submit 1/4" (minimum) scale plan view and elevation view outline drawings of switchgear showing dimensions, arrangements, electrical ratings, components, and weights.

C. Wiring Diagrams: Submit wiring diagrams for switchgear showing connections to electrical power feeders and distribution branches. Differentiate between portions of electrical wiring that are manufacturer-installed and portions that are field-installed.

D. Certification of Ratings: Furnish certification of ratings of the basic switch and fuse components and/or the integrated pad-mounted switchgear assembly consisting of the switch and fuse components in combination with the enclosure. Certification of the integrated unit shall include testing the pad-mounted switchgear to the fault-close requirements of the specification to assure the bus support system and components are adequate.

E. Certification of Finish: Furnish certified test abstracts substantiating the finish requirements of the switchgear enclosure.

F. Field startup report and demonstration and Owner training certification signoff sheet.

1.5 OPERATION & MAINTENANCE MANUALS

A. Provide O&M Manuals that describe installation, operation, and maintenance of the equipment furnished, complete with all wiring and schematic diagrams.

B. Instruction 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 also be provided in electronic (.pdf) formal on a USB thumb drive as part of the Project O&M Manuals under Section 017823 – Operation and Maintenance Data.

2. Each hard copy of the manuals shall be assembled and bound into hard-back, post-type binders suitable for rough usage. Snap-ring binders are not acceptable.

3. Prepare binder cover and spline inserts with printed title, “OPERATION AND MAINTENANCE INSTRUCTIONS”, 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

1.6 QUALITY ASSURANCE

A. Electrical Code Compliance: Comply with applicable local code requirements of the authority having jurisdiction and NEC, including Article 245.21(E) which specifies that the interrupter switches in combination with power fuses shall be coordinated electrically so that they will safely withstand the effects of closing, carrying, and interrupting all possible currents up to the assigned maximum short-circuit rating and the applicable portions of Article 495.

B. IEEE Compliance: Comply with applicable requirements of all applicable IEEE Standards, including Standard 241, "Recommended Practice for Electrical Power Systems in Commercial Buildings," pertaining to switchgear and IEEE Standard C37.74, “Standard Requirements for Subsurface, Vault, and Padmounted Load-Interrupter Switchgear and Fused Load-Interrupter Switchgear for Alternating Current Systems up to 38 kV”.

C. ANSI Compliance: Comply with applicable requirements of all applicable ANSI standards, including C57.12.28 "Pad-Mounted Equipment Enclosures" covering enclosure integrity for pad-mounted equipment.

D. NEMA Compliance: Comply with applicable portions of all applicable NEMA Standards, including Publication SG-5 "Power Switchgear Assemblies."

E. The switchgear assembly shall be UL Listed and Labeled.

1.7 EXTRA MATERIALS

A. Provide three (3) spare solid-material power fuse refill units of each size and type used on this project.

B. Provide two (2) 9-ounce, minimum, aerosol cans each of red-oxide primer and the Munsell 7GY3.29/1.5 topcoat paint for touching up scratches in the switchgear enclosure paint finish.

PART 2 - PRODUCTS

2.1 GENERAL

A. Each pad-mounted switchgear unit shall consist of a single self-supporting outdoor, weatherproof enclosure, containing interrupter switches and power fuses with the necessary accessory components, all completely factory-assembled and operationally checked.

B. The switchgear unit shall contain four compartments. Compartments 1, 2 and 4 shall each contain a non-fusible, three-pole, gang-operated interrupter switch connected to a common bus. Compartments 3 shall either contain one set of three disconnecting type power fuses or shall be empty based on the configuration indicated on the Drawings for each switchgear unit.

C. The electrical characteristics of the switchgear shall be:

1. kV, Nominal 14.4
2. kV, Maximum 17.0
3. kV, BIL 95
4. Main Bus Continuous
    a. Continuous Amperes 600
    b. Peak Withstand Amperes 36,400
    c. 1-Second, Short Time Withstand Amperes, RMS Sym. 14,000
5. Three-Pole Interrupter Switches
    a. Continuous Amperes 600
    b. Load Dropping Amperes 600
    c. Peak Withstand Amperes 36,400
    d. 1-Second, Short Time Withstand Amperes, RMS Sym. 14,000
    e. 3-Time Duty-Cycle Fault-Closing Amperes, RMS Sym 14,000

6. Short-Circuit Ratings

   a. Peak Withstand Amperes 36,400
      (Switchgear with fuse refill unit and holder construction) . 32,500

   b. 1-Second, Short Time Withstand Amperes, RMS Sym. 14,000
      (Switchgear with fuse refill unit and holder construction) . 12,500

   c. MVA Three-Phase Symmetrical at Rated Nominal Voltage ... 350
      (Switchgear with fuse refill unit and holder construction..... 310

7. Power Fuses with Integral Load Interrupters

   a. Maximum Amperes .....200E or 200K

   b. Load-Dropping Amperes 200

   c. 3-Time Duty-Cycle Fault-Closing Amperes, RMS Sym.... 14,000
      (Switchgear with fuse refill unit and holder construction) . 12,500

D. The short-circuit and three-time duty-cycle fault-closing ratings of switches, short-circuit rating of bus, interrupting ratings of fuses, and duty-cycle fault-closing capabilities of fuses with integral load interrupters shall equal or exceed the short-circuit ratings of the pad-mounted switchgear.

E. The manufacturer of the pad-mounted switchgear shall be completely and solely responsible for the performance of the basic switch and fuse components as well as the complete integrated assembly as rated.

F. The interior of the switchgear shall contain three (3) 3-pole externally operated full-load interrupter switches and either an empty compartment or one (1) 3-pole set of single-phase power fuse mountings, all connected to a common 600-ampere bus. Fuses shall be disconnecting type and shall be so arranged as to be de-energized when open.

2.2 INSULATORS

A. The interrupter-switch and fuse-mounting insulators shall be of a cycloaliphatic epoxy resin system with characteristics and restrictions as follows:

1. Operating experience of at least twenty (20) years under similar conditions.

2. Adequate leakage distance established by test per IEC 60507, “Artificial Pollution Test on High Voltage Ceramic and Glass Insulators to be Used on AC Systems.”

3. Adequate strength for short-circuit stress established by test.

4. Conformance with applicable ANSI standards.

5. Homogeneity of the cycloaliphatic epoxy resin throughout each insulator to provide maximum resistance to power arcs. Ablation due to high temperatures from power arcs shall continuously expose more material of the same composition and properties so that no change in mechanical or electrical characteristics takes place because of arc-induced ablation. Furthermore, any surface damage to insulators during installation or maintenance of the pad-mounted switchgear shall expose material of the same composition and properties so that insulators with minor surface damage need not be replaced.

2.3 HIGH-VOLTAGE BUS

A. High-voltage bus and interconnections shall consist of copper bar CA110, square edge, hard temper per ASTM B187.

B. Bus and interconnections shall withstand the stresses associated with short-circuit currents up through the maximum rating of the pad-mounted switchgear.

C. Bolted copper-to-copper connections shall have silvered interfaces and shall be made with 1/2"-13 stainless-steel bolts with two brass flat washers per bolt, one under the bolt head and one under the nut, and with a stainless-steel split lock washer between the flat washer and the nut. These bolts shall be tightened to the appropriate torque to ensure a good electrical and mechanical connection.

D. Tie bus shall consist of continuous, one-piece sections of copper bar with no intermediate splices. Flexible braid or cable shall not be used.

E. All bus terminals shall be copper.

2.4 PROVISIONS FOR GROUNDING

A. A ground-connection pad shall be provided in each termination compartment of the pad-mounted switchgear.

B. The ground-connection pad shall be constructed of no less than 3/8 in.-thick nickel-plated steel or 1/4 in.-thick stainless steel. The ground pad shall be welded to the enclosure and shall have a short-circuit rating equal to that of the pad-mounted switchgear.

C. Ground-connection pads shall be coated with a uniform coating of an oxide inhibitor and sealant prior to shipment.

D. A copper ground stud shall be provided for each terminal and ground pad in each bus, interrupter switch and fuse compartment.

2.5 ENCLOSURE

A. To ensure a completely coordinated design, the pad-mounted switchgear shall be constructed in accordance with the minimum construction specifications of the fuse and/or switch manufacturer to provide adequate electrical clearances and adequate space for fuse handling.

B. In establishing the requirements for the enclosure design, consideration shall be given to all relevant factors such as controlled access, tamper resistance, corrosion resistance, and resistance to entry of foliage, animals, and airborne contaminants.

C. The pad-mounted switchgear enclosure shall be unitized monocoque (not structural-frame-and-bolted sheet) construction to maximize strength, minimize weight, and inhibit corrosion.

D. The basic material shall be 11-gauge hot-rolled, pickled, and oiled steel sheet.

E. All structural joints and butt joints shall be welded, and the external seams shall be ground flush and smooth. The gas-metal-arc welding process shall be employed to eliminate alkaline residues and to minimize distortion and spatter.

F. To guard against unauthorized or inadvertent entry, enclosure construction shall not utilize any externally accessible hardware.

G. The base shall consist of continuous 90-degree flanges, turned inward, and welded at the corners, for bolting to a concrete equipment pad or fiberglass box pad.

H. The door openings shall have 90-degree flanges, facing outward, which shall provide strength and rigidity as well as deep overlapping between doors and door openings to guard against water entry.

I. Polyurethane self-adhesive bumpers shall be placed on the left-hand door channel to prevent the right-hand door from abrading the paint, and on the center door divider to prevent the left-hand door from rubbing against the center door divider.

J. Enclosure top side edges shall overlap with roof side edges to create a mechanical maze that shall allow ventilation of high-voltage compartments to help keep the enclosure interior dry while discouraging tampering or insertion of foreign objects.

K. A heavy coat of insulating “no-drip” compound shall be applied to the inside surface of the roof to minimize condensation of moisture thereon.

L. Insulating interphase and end barriers of NEMA GP03-grade fiberglass-reinforced polyester shall be provided for each interrupter switch and each set of fuses where required to achieve BIL ratings. Additional insulating barriers of the same material shall separate the front compartments from the rear compartments and isolate the tie bus (where furnished).

M. Full-length steel barriers shall separate adjoining termination compartments.

N. Interrupter switches shall be provided with dual-purpose front barriers. These barriers, in their normal hanging positions, shall guard against inadvertent contact with live parts. It shall be possible to lift these barriers out and insert them into the open gap when the switch is open. These barriers shall meet the requirements of Section 381G of the National Electrical Safety Code (ANSI Standard C2).

O. Interrupter switches shall be provided with window panels to allow viewing of the switch position without removing the dual-purpose front barriers. Window panels shall be removable to facilitate phasing and shall be secured to the enclosure with stainless steel or zinc-nickel plated hardware.

P. Each fuse shall be provided with a dual-purpose front barrier. These barriers, in their normal hanging positions, shall guard against inadvertent contact with live parts. It shall be possible to lift these barriers out and insert them into the open gaps when the fuses are in the disconnect position. These barriers shall meet the requirements of Section 381G of the National Electrical Safety Code (ANSI Standard C2).

Q. Inner barrier panels that meet the Rural Electrification Association's requirements for "dead-front" and the requirements of Section 381G of the National Electrical Safety Code (ANSI Standard C2) shall be provided – one for each door opening providing access to high voltage. These panels shall be secured in place with recessed penta-head bolts. When so secured, they shall guard against inadvertent contact with live parts.

R. Lifting tabs shall be removable. Sockets for the lifting-tab bolts shall be blind-tapped. A resilient material shall be placed between the lifting tabs and the enclosure to help prevent corrosion by protecting the finish against scratching by the tabs. To further preclude corrosion, this material shall be closed-cell to prevent moisture from being absorbed and held between the tabs and the enclosure in the event-that lifting tabs are not removed.

S. The enclosure shall be provided with an instruction manual holder.

T. An 11-gauge hot-rolled, pickled, and oiled sheet steel, non-compartmented base spacer shall be provided to increase the elevation of the base of the pad-mounted switchgear above the mounting pad by 12 inches. Base spacer exterior finish shall match that of the enclosure.

2.6 DOORS

A. Doors shall be constructed of 11-gauge hot-rolled, pickled, and oiled steel sheet.

B. Door-edge flanges shall overlap with door-opening flanges and shall be formed to create a mechanical maze that shall guard against water entry and discourage tampering or insertion of foreign objects, but shall allow ventilation to help keep the enclosure interior dry.

C. Doors shall have a minimum of two extruded-aluminum or stainless-steel hinges with stainless-steel hinge pins and interlocking extruded-aluminum hinge supports for the full length of the door to provide strength, security, and corrosion resistance. Mounting hardware shall be stainless steel or zinc-nickel-plated steel and shall not be externally accessible to guard against tampering.

D. In consideration of controlled access and tamper resistance, each set of double doors shall be equipped with an automatic three-point latching mechanism.

1. The latching mechanism shall be spring loaded and shall latch automatically when the door is closed. All latch points shall latch at the same time to preclude partial latching.

2. A pentahead socket wrench or tool shall be required to actuate the mechanism to unlatch the door and, in the same motion, recharge the spring for the next closing operation.

3. The latching mechanism shall have provisions for padlocking, using a padlock with up to a 3/8” shackle, which incorporates a means to protect the padlock shackle from tampering and that shall be coordinated with the latches such that:

a. It shall not be possible to unlatch the mechanism until the padlock is removed, and

b. It shall not be possible to insert the padlock until the mechanism is completely latched closed.

E. Doors providing access to solid-material power fuses shall have provisions to store up to three spare fuse refill units.

F. Each door shall be provided with a zinc-nickel-plated steel or stainless-steel door holder located above the door opening. The holder shall be hidden from view when the door is closed, and it shall not be possible for the holder to swing inside the enclosure.

G. To guard against corrosion, all hardware (including door fittings, fasteners, etc.), all operating-mechanism parts, and other parts subject to abrasive action from mechanical motion shall be of either nonferrous materials or galvanized or zinc-nickel-plated ferrous materials. Cadmium-plated ferrous parts shall not be used.

2.7 FINISH

A. Full coverage at joints and blind areas shall be achieved by processing enclosures independently of components such as doors and roofs before assembly into the unitized structures.

B. All exterior seams shall be filled and sanded or ground smooth for neat appearance.

C. All surfaces shall undergo a chemical cleaning, phosphatizing or zirconization and sealing process before any protective coatings are applied in order to remove oils and dirt, to form a chemically and anodically neutral conversion coating to improve the finish-to-metal bond, and to retard underfilm propagation of corrosion.

D. After pretreatment, protective coatings shall be applied that shall help resist corrosion and protect the steel enclosure.

E. The finishing system shall be installed without sags or runs.

F. After the finishing system has been properly applied and cured, welds along the enclosure bottom flange shall be coated with a wax-based anticorrosion moisture barrier to give these areas added corrosion resistance.

G. A resilient closed-cell material, such as PVC gasket, shall be applied to the entire underside of the enclosure bottom flange to protect the finish on this surface from scratching during handling and installation. This material shall isolate the bottom flange from the alkalinity of a concrete foundation to help protect against corrosive attack.

H. After the enclosure is completely assembled and the components (switches, fuses, bus, etc.) are installed, the finish shall be inspected for scuffs and scratches. Blemishes shall be touched up by hand to restore and protective integrity of the finish.

I. The finish shall be olive green, Munsell 7GY3.29/1.5.

2.8 INTERRUPTER SWITCHES

A. Interrupter switches shall have a three-time duty-cycle fault-closing rating equal to or exceeding the short-circuit rating of the pad-mounted switchgear. These ratings define the ability to close the interrupter switch three times against a three-phase fault with asymmetrical current in at least one phase equal to the rated value, with the switch remaining operable and able to carry and interrupt rated current. Tests substantiating these ratings shall be performed at maximum voltage with current applied for at least 10 cycles. Certified test abstracts establishing such ratings shall be furnished as part of the submittals required under Article 1.4 herein.

B. Interrupter switches shall be operated by means of an externally accessible 3/4" hex switch-operating hub. The switch-operating hub shall be located within a recessed stainless-steel pocket mounted on the side of the pad-mounted switchgear enclosure and shall accommodate a 3/4" deep-socket wrench or a 3/4" shallow-socket wrench with extension.

The switch-operating-hub pocket shall include a padlockable stainless-steel access cover that shall incorporate a hood to protect the padlock shackle from tampering. Stops shall be provided on the switch-operating hub to prevent overtravel and thereby guard against damage to the interrupter switch quick-make quick-break mechanism. Labels to indicate switch position shall be provided in the switch-operating-hub pocket.

C. Each interrupter switch shall be provided with a folding switch-operating handle. The switch-operating handle shall be secured to the inside of the switch-operating-hub pocket by a brass chain. The folded handle shall be stored behind the closed switch-operating-hub access cover.

D. Interrupter switches shall utilize a quick-make quick-break mechanism installed by the switch manufacturer. The quick-make quick-break mechanism shall be integrally mounted on the switch frame, and shall swiftly and positively open and close the interrupter switch independent of the switch-operating-hub speed.

E. Each interrupter switch shall be completely assembled and adjusted by the switch manufacturer on a single rigid mounting frame. The frame shall be of welded steel construction such that the frame intercepts the leakage path which parallels the open gap of the interrupter switch to positively isolate the load circuit when the interrupter switch is in the open position.

F. Interrupter switch contacts shall be backed up by stainless-steel springs to provide constant high contact pressure.

G. Interrupter switches shall be provided with a single blade per phase for circuit closing including fault closing, continuous current carrying and circuit interrupting. Spring-loaded auxiliary blades shall not be permitted. Interrupter switch blade supports shall be permanently molded in place in a unified insulated shaft constructed of the same cycloaliphatic epoxy resin as the insulators.

H. Circuit interruption shall be accomplished by use of an interrupter which is positively and inherently sequenced with the blade position. It shall not be possible for the blade and interrupter to get out of sequence. Circuit interruption shall take place completely within the interrupter, with no external arc or flame. Any exhaust shall be vented in a controlled manner through a deionizing vent.

I. Interrupter switches shall have a readily visible open gap when in the Open position to allow positive verification of switch position.

J. Interrupter switch terminals shall be copper.

K. Copper ground studs shall be provided at all switch terminals. Copper ground studs shall also be provided on the ground pad in each interrupter switch compartment and on the terminals and ground pad in any bus compartment. The momentary rating of the ground studs shall equal or exceed the short-circuit rating of the pad-mounted switchgear.

L. Key interlocks shall be provided to guard against opening fuse-compartment doors unless both switches are locked open.

2.9 SOLID-MATERIAL POWER FUSES

A. Solid-material power fuses shall utilize refill-unit-and-holder or fuse-unit-and-end-fitting construction. The refill unit or fuse unit shall be readily replaceable and low in cost. Fuse mountings shall be disconnect style.

B. Fuse holders shall be S&C Type SML-4Z.

C. Fuse refill units shall be S&C Type SM-4.

D. Fusible elements shall be nonaging and nondamageable so that it is unnecessary to replace unblown companion fuses following a fuse operation.

E. Fusible elements for refill units or fuse units, rated 10 amperes or larger, shall be helically coiled to avoid mechanical damage due to stresses from current surges.

F. Fusible elements that carry continuous current shall be supported in air to help prevent damage from current surges.

G. Refill units and fuse units shall have a single fusible element to eliminate the possibility of unequal current sharing in parallel current paths.

H. Solid-material power fuses shall have melting time-current characteristics that are permanently accurate to within a maximum total tolerance of 10% in terms of current. Time-current characteristics shall be available which permit coordination with source-side and load-side protective relays, automatic circuit reclosers, and other fuses.

I. Solid-material power fuses shall be capable of detecting and interrupting all faults whether large, medium or small (down to minimum melting current), under all realistic conditions of circuitry, with line-to-line or line-to-ground voltage across the fuse, and shall be capable of handling the full range of transient recovery voltage severity associated with these faults.

J. All arcing accompanying solid-material power fuse operation shall be contained within the fuse, and all arc products and gases evolved shall be effectively contained within the exhaust control device during fuse operation.

K. Solid-material power fuses shall be equipped with a blown-fuse indicator that shall provide visible evidence of fuse operation while installed in the fuse mounting.

L. Fuse terminal pads shall be provided with a two-position copper adapter, making it possible to accommodate a variety of cable-terminating devices.

M. Copper ground studs shall be provided at all fuse terminals. One copper ground stud shall also be provided on the ground pad in each fuse compartment. The momentary rating of the ground studs shall equal or exceed the short-circuit ratings of the pad-mounted switchgear.

2.10 LABELING

A. All external doors shall be provided with “Warning – High Voltage – Keep Out” or "Warning-Keep Out-Hazardous Voltage Inside-Can Shock, Burn, or Cause Death" signs.

B. The inside of each door shall be provided with a "Danger-Hazardous Voltage-Failure to Follow These Instructions Will Likely Cause Shock, Burns, or Death" sign. The text shall further indicate that operating personnel must know and obey the employer's work rules,

know the hazards involved, and use proper protective equipment and tools to work on this equipment.

C. Interrupter switch compartments shall be provided with "Danger" signs indicating that "Switches May Be Energized by Backfeed".

D. Fuse compartments shall be provided with "Danger" signs indicating that "Fuses May Be Energized by Backfeed."

E. Barriers used to prevent access to energized lives parts shall be provided with "Danger-Keep Away-Hazardous Voltage-Will Shock, Burn, or Cause Death" signs.

F. The outside of each door set of double doors shall be provided with a nameplate indicating the manufacturer's name, catalog number, model number, date of manufacture and serial number.

G. The inside of each set of double doors shall be provided with a ratings label indicating the following:

1. Overall pad-mounted switchgear ratings:
    a. Nominal Voltage, kV
    b. Maximum Voltage, kV
    c. BIL Voltage, kV
    d. Power Frequency, Hz
    e. Short-Circuit Peak Withstand Current, Amperes, Peak
    f. Short-Circuit One-Second Short-Time Withstand Current, Amperes, RMS Symmetrical
    g. Short-Circuit MVA, Three-Phase Symmetrical at Rated Nominal Voltage
2. Main bus ratings:
    a. Continuous Current, Amperes
    b. Peak Withstand Current, Amperes, Peak
    c. One-Second Short-Time Withstand Current, Amperes, RMS Symmetrical
3. Switch ratings:
    a. Continuous Current, Amperes
    b. Load Splitting Current, Amperes
    c. Load Dropping Current, Amperes
    d. Peak Withstand Current, Amperes, Peak
    e. One-Second Short-Time Withstand Current, Amperes, RMS Symmetrical
    f. Three-Time Duty-Cycle Fault-Closing Current, Amperes, RMS Symmetrical
4. Fuse type and integral load interrupter ratings and capabilities:
    a. Maximum Current, Amperes
    b. Load Splitting Current, Amperes

c. Load Dropping Current, Amperes

d. Duty-Cycle Fault-Closing Current, Amperes, RMS Symmetrical or Asymmetrical

H. A label from a National Recognized Testing Laboratory (NRTL) indicating the equipment is UL listed shall be applied to the inside of the switchgear in a readily visible location.

I. A three-line connection diagram showing interrupter switches, fuses with integral load interrupters, and bus, along with the manufacturer's model number, shall be provided on the inside of each door (or set of double doors), and on the inside of each switch-operating-hub access cover.

2.11 ACCESSORIES

A. End fittings and fuse unit, fuse holder and refill unit shall be furnished for each fuse mounting.

2.12 ACCEPTABLE MANUFACTURERS

A. Provide medium-voltage pad-mounted switchgear by one of the following:

1. S & C Electric Company Model PMH-11 and PMH-13, as indicated on the Drawings

2. Approved equals by Federal Pacific Electric

PART 3 - EXECUTION

3.1 INSTALLATION

A. Disconnect all medium voltage power cables and equipment grounding conductors from existing pad-mounted switchgear that is to be replaced and unbolt the switchgear from the fiberglass box pad.

B. Protect the existing power cables and grounding conductors from damage and lift the existing switchgear off the fiberglass box pad.

C. Install the new pad-mounted switchgear in the same orientation as the existing switchgear on the existing fiberglass box pad being careful not to damage the exiting power cables or equipment grounding conductors or the factory paint finish on the new switchgear. The new switchgear shall be installed in strict accordance with the manufacturer’s written installation instructions and per the details on Drawing E-501.

D. Bolt the switchgear to the existing equipment pad at all four corners using new stainless-steel hardware as indicated in the anchor bolt details on Drawing E-501.

E. Prep and touch-up all blemishes and scratches in the factory finish on the equipment in strict accordance with the equipment manufacturer’s instructions and using primer and touch-up paint provided by the equipment manufacturer.

3.2 STARTUP AND COMMISSIONING

A. Provide startup and commissioning of the equipment in accordance with the equipment manufacturer's recommendations in the presence of the Construction Representative and Owner's maintenance personnel.

B. Test functional operation of all interrupter switches and all power fuse units.

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 person who performed the equipment startup and commissioning services.

3.3 DEMONSTRATION AND OWNER TRAINING

A. Provide demonstration and training in accordance with the requirements of Section 017900 – Demonstration and Training.

B. Instruct the Owner's maintenance personnel on the proper operation and preventative maintenance of the switchgear and on servicing of all Owner serviceable components, including but not limited to:

1. Operation of interrupter switches
2. Opening interrupter switch termination access doors
3. Viewing position of switch blades
4. Opening fuse compartment access doors
5. Viewing the blown fuse indicator on power fuses
6. Accessing fuses
7. Removal and installation of fuses
8. Routine inspection, cleaning, and maintenance of the switchgear

C. Provide sign-off sheet documenting the date and time of the training, names of all attendees, name of person conducting the training and their Company contact information with sign-off by trainer and the Owner's Representative.

END OF SECTION 337710