

ADDENDUM NO. 2

TO: PLANS AND SPECIFICATIONS FOR STATE OF MISSOURI

**Upgrade Generator Controls & Transfer Switch
Moberly Correctional Center
Moberly, Missouri
PROJECT NO.: C1920-01**

Bid Opening Date: 1:30 PM, November 20, 2025 (Not Changed)

Bidders are hereby informed that the construction Plans and/or Specifications are modified as follows:

SPECIFICATION CHANGES:

1. Section 000110 – Table of Contents

- a. CHANGE the number of pages for Section 230900 – Instrumentation and Control for HVAC to 21 pages.
- b. CHANGE the number of pages for Section 260533.13 – Conduit for Electrical Systems to 14 pages.
- c. CHANGE the number of pages for Section 263213.16 – Diesel-Engine-Driven Generator Set Controls to 20 pages.
- d. ADD Section 263290 – Medium-Voltage Generator Connection Cabinet to the Table of Contents, 6 pages.
- e. ADD Section 263623 – Medium-Voltage Automatic Transfer Switches to the Table of Contents, 32 pages.
- f. ADD Section 263623 – Attachment 1 – Document C0 – Generator Connection Request Form to the Table of Contents, 18 pages.

2. Section 000115 – List of Drawings

- a. CHANGE the title of Drawing ED-602 to One-Line Diagram – Existing Condition.
- b. CHANGE the title of Drawing E-602 to One-Line Diagram – New Work.

3. Section 230900 – Instrumentation and Control for HVAC

- a. DELETE this Section and REPLACE with attached Section 230900 (21 pages).

4. Section 260533.13 – Conduit for Electrical Systems

- a. DELETE this Section and REPLACE with attached Section 260533.13 (14 pages).

5. Section 263213.16 – Diesel-Engine-Driven Generator Set Controls

- a. DELETE this Section and REPLACE with attached Section 263213.16 (20 pages).

6. Section 263290 – Medium-Voltage Generator Connection Cabinet
 - a. ADD attached new Specification Section 263290 (6 pages).
7. Section 263623 – Medium-Voltage Automatic Transfer Switches
 - a. ADD attached new Specification Section 263623 (32 pages).
8. Section 263623 – Attachment 1 – Document C0 – Generator Connection Request Form
 - a. ADD attached new Attachment 1 to new Specification Section 263623 (18 pages).

DRAWINGS CHANGES:

1. SHEET G-002:
 - a. CHANGE title of Drawing ED-602 to One-Line Diagram – Existing Condition.
 - b. CHANGE title of Drawing E-602 to One-Line Diagram – New Work.
2. SHEET MI-401:
 - a. DELETE this Drawing and REPLACE with attached Drawing MI-401 – Mechanical – Instrumentation & Controls – Power Plant.
3. SHEET ES-101:
 - a. DELETE this Drawing and REPLACE with attached Drawing ES-101 – Electrical Site Plan.
4. SHEET ED-401:
 - a. DELETE Key Note 3 and ADD new Key Note 3 to read as follows:
 3. REMOVE CONDUCTORS/CABLES FROM EXIST CONDUIT(S) BACK TO SOURCE/DESTINATION. CONDUIT(S) TO REMAIN.
5. SHEET ED-601:
 - a. DELETE this Drawing and REPLACE with attached Drawing ED-601 – Electrical One-Line Diagram – Demolition – 4.16kV.
6. SHEET ED-602:
 - a. DELETE this Drawing and REPLACE with attached Drawing ED-602 – Electrical One-Line Diagram – Existing Condition.
7. SHEET E-401:
 - a. DELETE this Drawing and REPLACE with attached Drawing E-401 – Electrical Plan – Power Plant.

8. SHEET E-501:
 - a. DELETE this Drawing and REPLACE with attached Drawing E-501 – Electrical & Fence Details.
9. SHEET E-601:
 - a. DELETE this Drawing and REPLACE with attached Drawing E-601 – One-Line Diagram – New Work – 4.16kV.
10. SHEET E-602:
 - a. DELETE this Drawing and REPLACE with attached Drawing E-602 – One-Line Diagram – New Work.

GENERAL COMMENTS:

1. The Pre-Bid Meeting was held October 28, 2025, followed by an inspection of the project site. The sign-in sheet is attached.
2. Bidders desiring to perform a site inspection should contact DOC staff James Harms, (660) 263-3778, James.Harms@doc.mo.gov, Joel Harms, (573) 690-0645, Joel.Harms@doc.mo.gov, or Justin Bax, at (573) 751-3911, Justin.Bax@doc.mo.gov to schedule a time to enter the facility/Power House.
3. Please contact Mandy Roberson, Contract Specialist, at (573) 522-0074, Mandy.Roberson@oa.mo.gov for questions about bidding procedures, MBE\WBE\SDVE Goals, and other submittal requirements.
4. The deadline for technical questions was Wednesday, November 5, 2025, at noon (12 pm).
5. Changes to, or clarification of, the bid documents are only made as issued in the addenda.
6. All correspondence with respect to this project must include the State of Missouri project number as indicated above.
7. Current Planholders list is available online at: [C1920-01 Upgrade Generator Controls & Transfer Switch-Moberly Correctional Center :: Plan Holders :: State of Missouri Office of Administration](#).
8. Prospective Bidders contact American Document Solutions, 1400 Forum Blvd Suite 7A, Columbia MO 65203, (573) 446-7768 to get plans and specifications.
9. **All bids shall be submitted on the bid form without additional terms and conditions, modifications, or stipulations. Each space on the bid form shall be properly filled. Failure to do so will result in rejection of the bid.**
10. **MBE/WBE/SDVE participation requirements can be found in DIVISION 00. The MBE/WBE/SDVE participation goals are 0%/0%/3%, respectively. Only certified firms as of the bid opening date can be used to satisfy the MBE/WBE/SDVE participation goals for this project. If a bidder is unable to meet a participation goal, a Good Faith Effort Determination Form must be completed, 3 contacts required (minimum). Failure to complete this process will result in rejection of the bid.**

ATTACHMENTS:

1. Revised Specification Section 230900 – Instrumentation and Control for HVAC (21 pages).
2. Revised Specification Section 260533.13 – Conduit for Electrical Systems (14 pages).
3. Revised Specification Section 263213.16 – Diesel-Engine-Driven Generator Set Controls (20 pages),
4. New Section 263290 – Medium-Voltage Generator Connection Cabinet (6 pages),
5. New Section 263623 – Medium-Voltage Automatic Transfer Switches (32 pages).
6. New Section 263623 – Attachment 1 (18 pages).
7. Revised Drawing MI-401 – Mechanical – Instrumentation & Controls – Power Plant.
8. Revised Drawing ES-101 – Electrical Site Plan.
9. Revised Drawing ED-601 – One-Line Diagram – Demolition – 4.16kV.
10. Revised Drawing ED-602 – One-Line Diagram – Existing Condition.
11. Revised Drawing E-401 – Electrical Plan – Power Plant.
12. Revised Drawing E-501 – Electrical & Fence Details.
13. Revised Drawing E-601 – One-Line Diagram – New Work – 4.16kV.
14. Revised Drawing E-602 – One-Line Diagram – New Work.

November 7, 2025

END ADDENDUM NO. 2

SECTION 230900 - INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes control equipment for HVAC systems and components.

1.3 SOLE SOURCE INSTRUMENTATION & CONTROLS SUBCONTRACTOR

- A. The existing Building Automation System (BAS) at the Moberly Correctional Center Power Plant was installed in 2018 by C&C Group.
 - 1. The installed BAS is founded upon a Schneider Electric StruxureWare platform.
- B. The sole source Power Plant BAS subcontractor for this project shall be C&C Group. Contact:
 - 1. Corey Schepers
 - 2. C&C Group
 - 3. cschepers@c-cgroup.com
 - 4. (913) 530-7369

1.4 BAS INTEGRATION WITH PACKAGED EQUIPMENT CONTROL SYSTEMS

- A. The existing Power Plant BAS shall interface with all new instrumentation and control systems, including instrumentation and control systems factory-packaged with new equipment.
 - 1. Provide BAS operator interface screens which duplicate factory-packaged operator interface screens.
 - 2. BAS shall monitor all available equipment system data, alarms, event history, etc. and provide critical equipment data collection, trending, and archiving.
 - 3. Factory-packaged equipment system control from the BAS is not required unless noted otherwise, but shall be a capability for future implementation.
 - 4. Packaged equipment communication interface is typically specified elsewhere to be BACnet or Modbus TCP/IP protocol.
 - 5. BAS system integrator shall coordinate with equipment manufacturer, field verify package equipment interface, and provide communication gateways as required.

1.5 GENERAL

- A. Instrumentation and control systems shall be fully coordinated and integrated with associated equipment and systems.
- B. Obtain all field information (dimensions, clearances, sizes, quantities, construction details, etc.) as required to properly complete the work.
- C. Control system subcontractor shall complete site visits as required to coordinate control system design with existing conditions.
- D. Submittals shall include control plans indicating the proposed location of all new controls.

1.6 DEFINITIONS

- A. DDC: Direct digital control.
- B. I/O: Input/output.
- C. LonWorks: A control network technology platform for designing and implementing interoperable control devices and networks.
- D. MS/TP: Master slave/token passing.
- E. PC: Personal computer.
- F. PID: Proportional plus integral plus derivative.
- G. RTD: Resistance temperature detector.

1.7 SYSTEM PERFORMANCE

- A. Comply with the following performance requirements:
 - 1. Graphic Display: Display graphic with minimum 20 dynamic points with current data within 5 seconds.
 - 2. Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within 5 seconds.
 - 3. Object Command: Reaction time of less than two seconds between operator command of a binary object and device reaction.
 - 4. Object Scan: Transmit change of state and change of analog values to control units or workstation within six seconds.
 - 5. Alarm Response Time: Annunciate alarm at workstation within 45 seconds. Multiple workstations must receive alarms within five seconds of each other.
 - 6. Program Execution Frequency: Run capability of applications as often as five seconds, but selected consistent with mechanical process under control.
 - 7. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.

8. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:
 - a. Space Temperature: Plus or minus 0.5 deg F.

1.8 SEQUENCE OF OPERATION

- A. Refer to the drawings for Sequence of Operations.

1.9 ACTION SUBMITTALS

- A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
 1. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.
 2. Control System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications.
 3. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.
- B. Control Plans: Control plan drawings indicating the location of all new controls.
- C. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 1. Bill of materials of equipment indicating quantity, manufacturer, and model number.
 2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
 3. Wiring Diagrams: Power, signal, and control wiring.
 4. Details of control panel faces, including controls, instruments, and labeling.
 5. Written description of sequence of operation.
 6. Schedule of dampers including size, leakage, and flow characteristics.
 7. Schedule of valves including flow characteristics.
 8. DDC System Hardware:
 - a. Wiring diagrams for control units with termination numbers.
 - b. Schematic diagrams and floor plans for field sensors and control hardware.

- c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.
- 9. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.
- 10. Controlled Systems:
 - a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
 - b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
 - c. Written description of sequence of operation including schematic diagram.
 - d. Points list.
- D. Samples for Initial Selection: For each color required, of each type of wall-mount thermostat or sensor cover with factory-applied color finishes.
- E. Samples for Verification: For each color required, of each type of thermostat or sensor cover.
- F. Coordination Plan: For each control system, list critical coordination activities to be completed with testing, adjusting, and balancing contractor and equipment service representatives.

1.10 INFORMATIONAL SUBMITTALS

- A. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with ASHRAE 135.
- B. Qualification Data: For manufacturer, designer, programmer, and installer.
- C. Software Upgrade Kit: For Owner to use in modifying software to suit future systems revisions or monitoring and control revisions.
- D. Field quality-control, calibration, testing, and adjusting reports.

1.11 CLOSEOUT SUBMITTALS

- A. As-built shop drawings, final system programming, and final system graphics.
- B. Operation and Maintenance Data: For HVAC instrumentation and control system to include in emergency, operation, and maintenance manuals. Data shall include, but not be limited to, the following:
 - 1. Maintenance instructions and lists of spare parts for each type of control device.
 - 2. Interconnection wiring diagrams with identified and numbered system components and devices.

3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
 4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
 5. Calibration records and list of set points.
- C. Software and Firmware Operational Documentation: Include the following:
1. Software operating and upgrade manuals.
 2. Program Software Backup: On a compact disc, complete with data files.
 - a. Backup shall completely restore the system in the event of a computer malfunction.
 - b. Provide two complete sets of back-up disc(s).
 3. Device address list.
 4. Printout of software application and graphic screens.
 5. Software license required by and installed for DDC workstations and control systems.
- D. Warranty Certificates.
- E. Extended Service Agreement

1.12 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish recommended spare parts and price list.

1.13 QUALITY ASSURANCE

- A. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this project.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with ASHRAE 135 for DDC system components.

1.14 WARRANTY

- A. Warranty shall cover all costs for parts, labor, associated travel, and expenses for a period of one year from final completion and formal system acceptance by Owner's Representative in writing.
- B. Hardware and software personnel supporting this warranty agreement shall provide on-site or off-site service in a timely manner upon failure notification. The maximum acceptable response time to provide this service at the site shall be 24 hours, Monday through Friday and 24 hours on Saturday and Sunday.

- C. This warranty shall apply equally to both hardware and software.

1.15 EXTENDED SERVICE AGREEMENT

- A. The controls contractor shall provide an extended service agreement for all control systems installed under this contract.
- B. During the one-year warranty period, the controls contractor will be required to provide a complete inspection and calibration of the control systems installed under this contract 6 months and 12 months after final acceptance of the project.
 - 1. Contractor will be required to repair or replace any defective components found during this inspection under the terms of the warranty.
 - 2. The Contractor shall submit a written report describing the results of his inspection.
- C. Beginning at the end of the one year warranty period and continuing for one year after this date, the Controls Contractor will be required to provide inspection and calibration of all controls installed under this contract 18 months and 24 months after final acceptance of the project.
 - 1. All components found defective during this inspection shall be repaired or replaced at no additional cost to the Owner.
- D. In addition to the regularly scheduled inspections, the Control Contractor, during the service agreement period, shall respond within 24 to non-emergency service requests and within 8 hours to emergency service requests by the Owner.
 - 1. The Contractor shall repair or replace any components found defective and recalibrate all necessary system controls to insure proper system operation at no additional cost to the Owner.

1.16 DELIVERY, STORAGE, AND HANDLING

- A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to equipment manufacturer.
- B. System Software: Update to latest version of software at project completion.

1.17 COORDINATION

- A. Coordinate location of exposed control sensors with plans, room details, and Owner's Representative before installation.
- B. Coordinate with control systems included with equipment furnished by others.
- C. Coordinate with fire-alarm systems to achieve compatibility with equipment that interfaces with that system.
- D. Coordinate supply of conditioned electrical branch circuits for control units and operator workstation.

- E. Coordinate with panelboards and motor control centers to achieve compatibility with starter coils, motor starters, and annunciation devices.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 CONTROL SYSTEM

- A. Manufacturers:
 - 1. Sole Source:
 - a. Schneider Electric/Invensys Building Systems through C&C Group.
 - b. Compatible with existing Power Plant Schneider Electric StruxureWare control system.
- B. Control system shall consist of sensors, indicators, actuators, final control elements, operator interface equipment, communication systems, power supplies, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems. An operator workstation, which permits interface with the network via dynamic color graphics for each mechanical system and control device depicted by point-and-click graphics, shall be provided.

2.3 DDC EQUIPMENT

- A. Integrate new DDC equipment with existing power plant DDC system.
- B. All new DDC equipment shall have a communications interface, which complies with ASHRAE Standard 135-2016, Bacnet™ -- A Data Communication Protocol For Building Automation And Control NETWORKS, to allow future integration with a new plant DDC system.
- C. Operator Interface: Panel mount, touch screen interface, with minimum 7-inch diagonal, high resolution, wide-screen format, color LCD, provided with custom, application specific, real-time graphics and application software.
- D. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.
 - 1. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation or diagnostic terminal unit.

2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
 - a. Global communications.
 - b. Discrete/digital, analog, and pulse I/O.
 - c. Monitoring, controlling, or addressing data points.
 - d. Software applications, scheduling, and alarm processing.
 - e. Testing and developing control algorithms without disrupting field hardware and controlled environment.
 3. Standard Application Programs:
 - a. Control units shall be fully custom programmable.
 4. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
 5. ASHRAE 135 Compliance: Control units shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.
- E. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.
1. Units monitor or control each I/O point, process information, and download from or upload to operator workstation or diagnostic terminal unit.
 2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
 - a. Global communications.
 - b. Discrete/digital, analog, and pulse I/O.
 - c. Monitoring, controlling, or addressing data points.
 3. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
 4. ASHRAE 135 Compliance: Control units shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.
- F. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.
1. Binary Inputs: Allow monitoring of on-off signals without external power.
 2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
 3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
 4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation with three-position (on-off-auto) override switches and status lights.
 5. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA).
 6. Tri-State Outputs: Provide two coordinated binary outputs for control of three-point, floating-type electronic actuators.

7. Universal I/Os: Provide software selectable binary or analog outputs.
- G. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:
 1. Output ripple of 5.0 mV maximum peak to peak.
 2. Combined 1 percent line and load regulation with 100-mic.sec. response time for 50 percent load changes.
 3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.
- H. Power Line Filtering: Internal or external transient voltage and surge suppression for workstations or controllers with the following:
 1. Minimum dielectric strength of 1000 V.
 2. Maximum response time of 10 nanoseconds.
 3. Minimum transverse-mode noise attenuation of 65 dB.
 4. Minimum common-mode noise attenuation of 150 dB at 40 to 100 Hz.

2.4 UNITARY CONTROLLERS

- A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.
 1. Configuration: Local keypad and display; diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and **72**-hour battery backup.
 2. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. Perform automatic system diagnostics; monitor system and report failures.
 3. ASHRAE 135 Compliance: Communicate using read (execute and initiate) and write (execute and initiate) property services defined in ASHRAE 135. Reside on network using MS/TP datalink/physical layer protocol and have service communication port for connection to diagnostic terminal unit.
 4. Indoor Enclosure: Dustproof rated for operation at 32 to 120 deg F.
 5. Outdoor Enclosure: Waterproof rated for operation at 40 to 150 deg F.

2.5 ALARM PANELS

- A. Unitized cabinet with suitable brackets for wall or floor mounting. Fabricate of 0.06-inch-thick, furniture-quality steel or extruded-aluminum alloy, totally enclosed, with hinged doors and keyed lock and with manufacturer's standard shop-painted finish. Provide common keying for all panels.
- B. Indicating light for each alarm point, single horn, acknowledge switch, and test switch, mounted on hinged cover.

1. Alarm Condition: Indicating light flashes and horn sounds.
2. Acknowledge Switch: Horn is silent and indicating light is steady.
3. Second Alarm: Horn sounds and indicating light is steady.
4. Alarm Condition Cleared: System is reset and indicating light is extinguished.
5. Contacts in alarm panel allow remote monitoring by independent alarm company.

2.6 ELECTRONIC SENSORS

- A. Description: Vibration and corrosion resistant; for wall, immersion, pipe, or duct mounting as required.
- B. Space Thermostat Sensor:
 1. Accuracy: Plus or minus 0.5 deg F.
 2. Integral Display: LCD display of space temperature and setpoint. Display shall indicate if display is actual temperature or setpoint.
 3. Operator Input: Exposed setpoint adjustment buttons.
 4. Communications: Capable of future connection to future building automation system, DDC, application specific controller, or device controller via digital data connection.
 5. Room Sensor Cover Construction: Manufacturer's standard locking covers.
 - a. Set-Point Adjustment: Exposed.
 - b. Temperature & Set-Point Indication: Exposed.
 - c. Color: Provide color charts for Owner selection
 - d. Orientation: Vertical, wall mount.

2.7 FLOW METER – ELECTROMAGNETIC TYPE (FE/FIT)

- A. Flow meter shall be electromagnetic type which measures fluid flow using Faraday's law of electromagnetic induction (i.e Induced voltage is directly proportional to the velocity of the conductive liquid.).
- B. Meter shall have a uniform magnetic field flux distribution which eliminates the need for piping straight meter runs and flow profiling.
- C. Meter shall be suited for measuring dynamic, non-continuous flow.
- D. Meter shall operate with +/- 0.25% accuracy at a 300:1 turndown without flow profiling or a piping straight run exceeding 1.5 pipe diameters from meter centerline in all piping configurations.
- E. Meter K-factor shall be stable and not influenced by external piping or mounting orientation.

- F. Flow meter shall consist of a full-bore body with an encapsulated and rigidly retained set of coils and microprocessor based converter/transmitter as follows:
1. Flow Element Housing: Carbon steel, flanged, polyurethane resin coating.
 2. Flanges: Forged, carbon steel, ASTM A105, raised face, weld neck, ANSI B16.5, Class 150.
 3. Fluid Temperature Range: -4 F to 248 F.
 4. Pressure Rating: Full Vacuum to 150 psig at 248 F.
 5. Minimum Fluid Conductivity: 3 microsiemens per centimeter.
 6. Flow Range: 0 to 33 feet per second.
 7. Flow Accuracy: $\pm 0.25\%$ of rate above 0.11 feet per second.
 8. Lining:
 - a. PFA (Teflon) with 250 F continuous duty temperature rating, unless noted otherwise.
 9. Electrode: Hastelloy C22.
 10. Grounding Ring: Hastelloy C.
 11. Converter/Transmitter Mounting: Remote.
 12. Converter/Transmitter Structure: Aluminum Alloy, IP 67, NEMA 4X watertight, baked acrylic resin coating.
 13. Display: LCD.
 14. Flow Signal Output: 4 to 20 mAdc and pulse.
 15. Repeatability: $\pm 0.5\%$ of rate.
 16. Digital Outputs: Empty pipe alarm.
 17. Communications: Hart protocol.
 18. Power Supply: 100 to 240 Vac, 60 Hz, 20 watts maximum.
 19. Ambient Temperature Range: -40 F to 140 F.
 20. Vibration Resistance: 10 to 150 Hz with 9.8 meters per second² acceleration.
- G. Flow meter shall be hydrostatically tested.
- H. Flow meter shall be factory calibrated in a NIST traceable flow test facility which is capable of $\pm 0.25\%$ calibration accuracy. Calibration tests shall be recorded, certified, and supplied with each meter. Calibration tests shall include, but not be limited to, the following:
1. Accuracy of flow indication at three (3) test points over a range of minimum to maximum flow.
 2. Flow coefficients over an approximate Reynolds Number range corresponding to the minimum and maximum flows.
 3. Calibration tests shall be performed on the actual meters provided.
- I. Flow meter calculations and associated transmitter calibration and configuration shall be based on calibration test results.

- J. Acceptable manufacturers, subject to compliance with specifications:
 - 1. Cadillac® CMAG, or approved equal by Badger, Foxboro, Emerson.

2.8 ELECTRIC ACTUATORS - DAMPERS

- A. Sized for damper break-away and operating torque requirements with sufficient reserve power to provide smooth action and proper speed of response at worst cast damper conditions.
 - 1. Field verify torque requirements on existing dampers to remain in place.
- B. Provide all mounting hardware and linkages.
- C. Two-Position Actuators:
 - 1. 120-volt, single phase, electric powered.
 - 2. ISO 9001, cULus, CE, and CSA listed.
 - 3. NEMA 4, UL Type 4 approved, IP 66 rated, aluminum housing with plastic junction box.
 - 4. Brushless motor technology, with microprocessor control, protected for overload at all angles of rotation, 75 second run time (max.)
 - 5. -22 to 122 F temperature range, 95% relative humidity, non-condensing.
 - 6. Fail-safe operation, with continuously engaged mechanical spring return that returns to damper fail-safe position within 10 seconds of power loss at -4 F to 122 F and within 15 seconds at -22 F to -4 F.
 - a. Fail Safe Position as scheduled on drawings.
 - 7. Built-in limit end stop to match available damper rotation.
 - 8. Manual override with locking function.
 - 9. External position indicator.
 - 10. Two Auxiliary End switches set at 10° and 85° for position indication and equipment interlocks, SPDT, 3A resistive maximum load at 250Vac.
 - 11. Linkage – corrosion-resistant, provide members as required.
 - 12. 5-year warranty.
 - 13. Belimo EFCX or approved equal by control system manufacturers named above.
- D. Modulating Actuators:
 - 1. 24 VAC/DC, electric powered.
 - 2. Proportional control in response to a 2 to 10 VDC control signal.
 - 3. ISO 9001, cULus, CE, and CSA listed.
 - 4. NEMA 4, UL Type 4 approved, IP 66 rated, aluminum housing with plastic junction box.
 - 5. Brushless motor technology, with microprocessor control, internal feedback, protected for overload at all angles of rotation, 95 second run time (max.)
 - 6. -22 to 122 F temperature range, 95% relative humidity, non-condensing.

7. Fail-safe operation, with continuously engaged mechanical spring return that returns to damper fail-safe position within 20 seconds of power loss at -4 F to 122 F and within 60 seconds at -22 F to -4 F.
 - a. Fail Safe Position as scheduled on drawings.
8. Built-in limit end stop to match available damper rotation.
9. Manual override with locking function.
10. External position indicator.
11. Two Auxiliary End switches set at 10° and 85° for position indication and equipment interlocks, SPDT, 3A resistive maximum load at 250Vac.
12. Linkage – corrosion-resistant, provide members as required.
13. 2 to 10 VDC position feedback signal.
14. 5-year warranty.
15. Belimo EF Series or approved equal by control system manufacturers named above.

2.9 CONTROL CABLE

- A. Conduit and Raceway:
 1. Electrical Metallic Tubing: EMT and fittings shall conform to ANSI C80.3.
 2. Aluminum rigid conduit or Galvanized rigid steel conduit: Outdoors.
 3. Flexible Metal Conduit: Indoors, per National Electric Code for connection to moving or vibrating equipment,
 4. Liquidtight Flexible Conduit: Outdoors, per National Electric Code for connection to moving or vibrating equipment.
- B. Motor Interlock Wiring: Interlock circuit wiring shall be No. 14 stranded wire. Stranded wire only shall be used where wiring is used for flexible wiring harnesses. Stranded control wire shall be provided with crimp type spade terminators. Interlock circuit wiring shall be color-coded or numbered using an identical number on both ends of the conductor. Wire numbers shall be installed before conductors are pulled. Where motor interlock conductors are run in cable tray, furnish and install conductors or multiconductor cable rated for use in cable trays per NEC articles 392 and/or 725.
- C. Automation Input/Output Wiring: Wiring serving inputs and outputs from the automation system shall be cables consisting of single or multiple twisted pairs, an overall aluminum foil type shield with a 22 AWG stranded drain wire.
- D. Cables installed without conduit shall be plenum rated and comply with NEC article 725.
- E. All cable splices must be contained within a UL approved metal junction box.
- F. Multi-conductor cable shall only be used where all the points are at a single location and for the same device (i.e., variable frequency drives, each individual motor starter). Single conductor cables shall be used for all temperature transmitters, pressure transmitters, flow meters, differential pressure switches, control valves and any other locations where the points are not grouped together at the same device. Where automation input/output

wiring is run in cable tray furnish and install conductors or multi-conductor cable rated for use in cable trays per NEC articles 392 and/or 725. Conductors shall be a minimum 18 AWG wire gauge. All wires shall be continuous from outlet to outlet and there shall be no unnecessary slack in the conductors.

- G. Building Automation Network: Wiring serving communication trunks from the automation system shall be as required by the network protocol. Cables installed without conduit shall be plenum rated and comply with NEC article 725. Where wiring is run in cable tray furnish and install conductors or multi-conductor cable rated for use in cable trays per NEC articles 392 and/or 725.

2.10 AUXILIARY PANELS

A. Manufacturers

- 1. Hoffman
- 2. Hubbell-Wiegmann

B. Description

- 1. NEMA 12, Minimum 16ga steel bodies and 14ga steel doors sizes through 24" x 24", larger sizes all 14ga, seams continuously welded and ground smooth. Doors shall be hinged for 180° swing, oil resistant gasket, removable print pocket, door clamps with bolts, hasp and staple for padlocking. Collar studs shall be provided to mount a sub-panel. Finish shall be white inside and gray ANSI 61 outside over phosphatized surfaces. Subpanels shall be white polyester powder finish.

2.11 SPECIALTY TERMINAL BLOCKS

A. Manufacturers

- 1. Phoenix
- 2. Weidmuller
- 3. Entrelec
- 4. ABB

B. Description

- 1. Terminal blocks shall allow the entering conductor to be disconnected from the leaving conductor using sliding link, knife link or plug switch.
- 2. Terminals shall be rated for voltage and current of the circuit.
- 3. Terminals shall have test jacks and allow meter to be connected without interference of the disconnecting means.
- 4. Standard DIN EN50022 mounting rail mounting.

C. Components shall include, but not be limited to, the following:

- 1. Fuse holder terminal blocks: Provide with fuse station indicator.
- 2. Feed through terminal blocks.
- 3. Grounding type terminal blocks.

4. Resistor style terminal blocks.
5. Component holder terminal.

2.12 HYDROGEN GAS DETECTOR (Addendum No. 2, 11/07/25)

- A. Ambient air hydrogen gas analyzer shall be an industrial grade, microprocessor-based, continuous, ambient air, hydrogen monitoring system, suitable for lead acid battery emissions monitoring.**
- B. Analyzer shall be as follows:**
 - 1. Sensor: Catalytic type, single element, replaceable, 10 year life cycle, linear output.**
 - 2. Hydrogen Range: 0 – 2% by volume.**
 - 3. Response Time: <60 seconds T90.**
 - 4. Recovery Time: <60 seconds.**
 - 5. Factory calibration and configuration.**
 - 6. Alarm 1: 1% H2 by volume (25% of lower explosive limit).**
 - 7. Alarm 2: 2% H2 by volume (50% of lower explosive limit).**
 - 8. Fire Alarm: 2% H2 by volume.**
 - 9. Analog Signal: 0 – 2% H2 by volume.**
 - 10. Housing: ABS, flame retardant UL 94V-1.**
 - 11. Threaded plugs shall be furnished for unused conduit openings.**
 - 12. Mounting:**
 - a. Sensor: Ceiling mount with galvanized or coated steel mounting brackets.**
 - b. Remote Repeater: Wall mount with galvanized or coated steel mounting.**
 - 13. Local Operator interface: Thin film transistor display, touch screen, status LEDs (normal, Alarm 1, Alarm 2), circuit test push button, 80 dB alarm horn.**
 - a. With 10 year “End of Live” indicating function.**
 - 14. Analog Outputs: Two (2) selectable, 0 to 10 V or 4 to 20 mA, 24V DC, 2-wire.**
 - 15. Digital Outputs:**
 - a. Alarm 1: SPDT relay, 10 amp resistive, 0 - 15 second alarm delay, 0.2% volume deadband.**
 - b. Alarm 2: SPDT relay, 10 amp resistive, 0 - 15 second alarm delay, 0.2% volume deadband.**
 - c. Fire Alarm: SPST relay, normally open, 1 amp, 4 second alarm delay, 0.2% volume deadband.**

- d. **Gas detection system fault/trouble relay: SPST relay, normally open, 1 amp.**
- 16. **Communications: Modbus RTU.**
- 17. **Power: 24 Vac, 18 - 60 Vdc, or 90-250 Vac.**
- 18. **Ambient Temperature Range: -14°F to 104 °F.**
- 19. **Relative Humidity: 20 to 90% non-condensing.**
- 20. **Compliance: UL 1484 listed and labelled, CE/UKCA, BS EN 61010-1:2010, BS EN 50270**
- 21. **Accessories:**
 - a. **Repeater panel for remote installation at eye level, configurable for incorporating 3 gas detectors.**
 - b. **Test kit including two hydrogen gas cylinders, regulator, vinyl tubing, applicator cone, and case.**

C. Acceptable manufacturers, subject to compliance with specifications:

- 1. **Eagle Eye Power Solutions, Model HGD5000, or approved equal by BHS, Critical Environment Technologies Sensidyne.**

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that conditioned power supply is available to control units.
- B. Verify new control instruments and devices are suitable for existing control system.
- C. Verify that existing control systems, instruments, devices, etc., which are to remain, are operational.
 - 1. Check calibration and function on existing instrument and devices. Recalibrate as required.
 - 2. Submit calibration and test reports.
- D. Advise Owner's Representative and Engineer of any issues with existing equipment or controls to remain in service.

3.2 INSTALLATION

- A. Comply with manufacturers' instructions.
- B. Install software in control units and operator interfaces.
- C. Implement all features of programs to specified requirements and as appropriate to sequence of operation.
- D. Connect and configure equipment and software to achieve proper sequence of operation.

- E. Verify location of room temperature sensors and other exposed control sensors with existing conditions and Construction Representative before installation. Install devices 60 inches above the floor.
- F. Install guards on room sensors with setpoint adjustment capability.
- G. Install damper motors on outside of duct or damper frame.
- H. Install labels and nameplates to identify control components.

3.3 ELECTRICAL WIRING AND CONNECTION INSTALLATION

- A. General Requirements:
 - 1. Bundle and harness multiconductor instrument cables in place of single cables where several cables follow a common path.
 - 2. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
 - 3. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
 - 4. Install wire and cable with sufficient slack and flexible connectors to allow for vibration of piping and equipment.
 - 5. Raceway: Raceway is to be installed in accordance with the National Electric Code. Use of flexible metal conduit or liquidtight flexible conduit is limited to 36" to connect from EMT to devices subject to movement. Flexible raceway is not to be used to compensate for misalignment of raceway during installation.
- B. Install motor interlock wiring and power wiring (for Division 230900 components) as indicated below:
 - 1. All wiring shall be installed in raceway according to Section 260533.13 – Conduit for Electrical Systems.
- C. Install building automation network and automation input and output wiring. Cables shall be installed in raceway as described below.
 - 1. In mechanical spaces, cable shall be installed in raceway according to Section 260533.13 – Conduit for Electrical Systems.
 - 2. Above suspended ceiling, open plenum rated wiring will be permitted. Cables shall be supported with J-hooks a minimum of every six feet. Bridal rings can be used when supporting a maximum of 6 wires. Support devices are to be attached to permanent structure.
 - 3. At all other spaces not previously defined, cable shall be installed in raceway according to Section 260533.13 – Conduit for Electrical Systems.
- D. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.4 POWER FOR CONTROL PANELS, EQUIPMENT AND SYSTEMS

- A. Power for control panels, controllers, etc. shall be the responsibility of this section. Power shall be obtained from lighting panels, distribution panels or as indicated on drawings.
- B. The section shall be responsible for bringing all power required by, but not limited to actuators, transmitters, etc. from a main control system auxiliary panel to the point of use. This includes furnishing and installing any branch circuit protection equipment and disconnecting equipment required to comply with code requirements.
- C. The contractor shall extend existing equipment grounding system. The contractor shall use only approved grounding clamps and connectors as manufactured by Penn-Union, Burndy, or O-Z Manufacturing Company.
 - 1. Install a green equipment grounding conductor inside all conduits. Bond all junction boxes, conduit, and equipment. Terminate equipment grounding conductor at electrical panel grounding bus.

3.5 AUXILIARY PANELS INSTALLATION AND FABRICATION

- A. Auxiliary panels shall be fabricated to match the approved shop drawings submitted by the control contractor. Fabrication shall be in a neat and workmanlike manner and shall facilitate repair, maintenance, and adjustment of the equipment contained therein.
- B. All equipment that is not providing an input from a field sensed process (static pressure, temperature, proof of flow, etc.) shall be installed in an auxiliary panel located as indicated on the drawings or as directed by the engineer.
- C. Auxiliary panels shall be fabricated and laid out to incorporate the following features:
 - 1. Identification of all internally and cover mounted devices. Cover mounted labels shall be engraved labels. Labels for internal devices may be self-adhesive printed tape. Labels shall be mounted adjacent to the device they are associated with so that replacement of the device does not eliminate the label.
 - 2. All input and output wiring entering the stand alone control units shall be terminated on sliding link or knife switch type disconnecting type terminal strips to allow the field wiring to be isolated from the stand-alone unit for trouble shooting and to allow current loops to be tested without lifting any of the wiring. If such terminal strips are not furnished as a standard part of the stand-alone control unit termination points, then they shall be installed in an auxiliary panel located immediately adjacent to the stand-alone unit.
 - 3. All internal wiring shall be run inside plastic wiring duct as manufactured by Panduit. Wire duct shall be sized to hold the required number of wires without crimping the wires and with sufficient space to allow wiring to be traced during troubleshooting operation.
 - 4. Wires that pass from the panel interior to cover mounted devices shall be provided with a flex loop that is anchored on both sides of the hinge.
 - 5. All control panels shall be provided with removable sub-panels to allow the panel enclosures to be installed at the job site during rough in while the panels are fabricated off-site for later installation.

6. Provide strain relief type cord and cable connectors for all cables that leave the panel as individual cables not in conduit.
7. Provide one duplex outlet mounted inside the control panel and separately fused with a non-time delay fuse at 15 A at any panel location containing electronic or electrical control components. This receptacle may be served from the control panel's 120 VAC power source.
8. Provide one under cabinet type fluorescent light with switch mounted internally in the control panel.
9. Each panel shall be provided with a control power disconnect switch located and wired so as to disconnect all control power in the panel. The leaving side of this switch shall be wired to the panel and field components through a fuse or fuses sized and applied to protect both the components of the system as well as the wire and as required for code compliance.
10. All wiring leaving the panel shall be separated by classification; i.e., Class 1 circuits shall not be run with Class 2 circuits, etc. Segregation shall be maintained inside the panel to the fullest extent possible. Where low voltage wires carrying low level ac and dc signals cross wires containing power and high-level ac signals, the wires shall cross at a 90° angle.

3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation.
 - a. Remove and replace malfunctioning units and retest.
 2. Test and adjust controls and safeties.
 3. Test calibration of electronic controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
 4. Test each point through its full operating range to verify that safety and operating control set points are as required.
 5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
 6. Test each system for compliance with sequence of operation.
 7. Test software and hardware interlocks.
- C. DDC Verification:
 1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
 2. Check instruments for proper location and accessibility.
 3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.

4. Check installation of wiring for each instrument.
 5. Check temperature instruments and material and length of sensing elements.
 6. Check electric-operated dampers. Verify that proper blade alignment, either parallel or opposed, has been provided.
 7. Check DDC system as follows:
 - a. Verify that DDC controller power supply is from emergency power supply, if applicable.
 - b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
 - c. Verify that spare I/O capacity has been provided.
 - d. Verify that DDC controllers are protected from power supply surges.
- D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.7 ADJUSTING

- A. Calibrating and Adjusting:
1. Calibrate instruments.
 2. Make three-point calibration test for both linearity and accuracy for each analog instrument.
 3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
 4. Control System Inputs and Outputs:
 - a. Check analog inputs at 0, 50, and 100 percent of span.
 - b. Check analog outputs using milliampere meter at 0, 50, and 100 percent output.
 - c. Check digital inputs using jumper wire.
 - d. Check digital outputs using ohmmeter to test for contact making or breaking.
 - e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.
 5. Temperature:
 - a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
 - b. Calibrate temperature switches to make or break contacts.
 6. Stroke and adjust control dampers without positioners, following the manufacturer's recommended procedure, so that damper is 100 percent open and closed.

7. Stroke and adjust control dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
 8. Provide diagnostic and test instruments for calibration and adjustment of system.
 9. Provide written description of procedures and equipment for calibrating each type of instrument.
 10. Submit procedures review and approval before initiating startup procedures.
- B. Adjust initial temperature set points.
- C. Report results in writing.
- D. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other than normal occupancy hours for this purpose.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls.
- B. Provide a minimum of four (4) hours of instructions to Owner's personnel (6 to 12 people) in the operation and maintenance of the control system.
- C. The training shall be scheduled with the Owner's Representative to accommodate Owner's schedule but will be performed during normal business hours.
- D. Provide training after the system has been installed and checked out.

END OF SECTION 230900

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. Section 260500 – Common Work Results for Electrical
- B. **Section 260513 – Medium-Voltage Cables (ADDENDUM 2, 11/7/25)**
- 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

1.4 SUBMITTALS

- A. Manufacturer's product data sheets shall be submitted for the following items:
 - 1. Each type of conduit (galvanized rigid steel, rigid aluminum, electrical metallic tubing, liquidtight flexible metallic, rigid non-metallic)
 - 2. Conduit hubs
 - 3. **Conduit expansion fittings (ADDENDUM 2, 11/7/25)**
 - 4. Internal conduit sealing bushings
 - 5. External conduit sealing bushings
 - 6. Conduit bodies
 - 7. Conduit mounting clamps
 - 8. Fire-stopping materials
 - 9. Intumescent silicone sealant
 - 10. Protective coating for direct buried metal conduit
 - 11. Underground conduit warning tape
 - 12. 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 and inside the Power Plant.
 - 2. Rigid aluminum conduit (RAC), heavywall, copper-free threaded aluminum in accordance with ANSI C80.5 and shall meet the requirements of NEC Article 344.
 - a. Minimum conduit size shall be 1-1/2-inch.
 - b. Running threads are not permitted.
 - c. Rigid aluminum conduit may be substituted for GRC in sizes 1-1/2" and larger except as follows:
 - 1) Rigid aluminum conduit shall not be installed on the roof of a building.
 - 2) Rigid aluminum conduit shall not be installed in poured concrete.
 - 3) Rigid aluminum conduit shall not be installed in locations or environments known to be corrosive to aluminum.
 - 3. Electrical metallic tubing (EMT) shall be thin wall steel conduit, hot dipped galvanized on both the outside and the inside. EMT shall conform to ANSI Standard C80.3 and U.L. Standard 797 and shall meet the requirements of NEC Article 358.
 - a. Minimum conduit size shall be 3/4-inch.
 - b. All connectors and couplings shall be zinc plated steel. Die cast zinc type are not acceptable.
 - 1) Size 2-1/2" and smaller compression type
 - 2) Size 3" and larger set-screw type
 - c. Connectors up to and including size 1-1/2" shall be insulated throat type. All connectors shall be terminated with a bonding type locknut. Threaded steel insulated grounding bushings having solderless lugs shall be used on connector sizes 1-1/4" and larger.
 - d. EMT shall be used inside the Power Plant Control Room and Office.

4. Liquidtight flexible metal conduit (LFMC) shall be square locked galvanized steel flexible tubing having an extruded liquidtight thermoplastic or polyvinyl chloride (PVC) jacket, making the conduit moisture proof, oil proof, and sunlight resistant LFMC shall conform to U.L. Standard 360 and shall meet the requirements of NEC Article 350. Liquidtight flexible metal conduit shall be used at all locations where a flexible conduit connection is required.
 - a. Minimum conduit size shall be 1/2-inch.
 - b. Conduit and fittings shall be rated for 90°C conductors or cable and for use in direct sunlight.
 - c. Liquidtight flexible metal conduit shall contain a continuous copper ground built into the core in sizes 1/2-inch through 1-1/4-inch, and all sizes shall be approved and listed by Underwriters' Laboratories, Inc. (UL). Liquidtight flexible metal conduit shall be rated for a minimum temperature range of -20°C (-4°F) to +60°C (+140°F), and shall be as manufactured by the following:
 - 1) Anamet, Inc., Type UA
 - 2) Electri-Flex Company, Type LA Liqueatite
 - 3) Southwire/Alflex, Type UL Ultratite
 - d. All connectors and couplings for liquidtight flexible metal conduit shall be malleable iron with hot-dipped galvanized or steel with zinc plated finish, compression ring, positive ground, positive grip, liquid tight, rain-tight and oil tight.
 - e. All connectors and fittings shall be UL Listed as suitable for grounding in sizes 1/2-inch through 1-1/4-inch.
 - f. All connectors shall be insulated throat type. All connectors shall be terminated with a bonding type locknut. Threaded steel insulated grounding bushings having solderless lugs shall be provided on connector sizes 1-1/4" and larger.
 - g. All connectors in sizes 1-1/2-inch and larger shall have a grounding lug on the gland nut for connection of an external grounding conductor in accordance with Section 260526 - Grounding and Bonding for Electrical Systems.
 - h. Neither flexible metal conduit ("greenfield") nor liquidtight flexible nonmetallic conduit shall be substituted for liquidtight flexible metal conduit.
 - i. Unless otherwise indicated, liquidtight flexible metal conduit shall only be used for the final connection to:
 - 1) Vibrating type equipment, such as motors, HVAC equipment, and transformers (flexible connection not to exceed 3 feet).
 - 2) All remotely located control devices and instrumentation such as damper actuators, solenoid valves, position switches, limit switches, temperature transmitters, flow transmitters, etc. (flexible connection not to exceed 2 feet).
 - 3) As permitted elsewhere in these Specifications or Drawings.
5. Rigid non-metallic conduit shall be heavy wall Schedule 40 (NEMA EPC-40 PVC, Type II-III) polyvinyl chloride (PVC) electrical plastic conduit and shall meet the

requirements of NEC Article 352. Rigid non-metallic conduit shall be as manufactured by Carlon Electrical Products; Condux International, Inc.; Can-Tex Industries; Certainteed Products Corp.; or approved equal.

- a. Minimum conduit size shall be 1-inch.
- b. Rigid non-metallic conduit (PVC) shall only be used below grade.
- c. Adhesive for PVC conduit shall be as recommended by the manufacturer of the PVC conduit

2.2 CONDUIT HUBS

- A. Conduit hubs shall be 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 by Eaton Crouse-Hinds or Appleton Electric.
- 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 EXPANSION FITTINGS (ADDENDUM 2, 11/7/25)

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

2.4 CONDUIT SEALING BUSHINGS

- A. Internal Conduit Sealing Bushings: Designed to seal around the conductors/cables inside a conduit and shall have a one-piece, neoprene ring between two (2) PVC coated steel discs that are custom drilled 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

2.5 CONDUIT PENETRATION SEALING ASSEMBLIES

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

2.6 CONDUIT BODIES

- A. Conduit bodies shall be provided as required or where indicated on the Drawings and shall be hot-dipped galvanized malleable iron with galvanized steel gasketed covers or cast, “copper-free” aluminum having threaded hubs and stainless steel or “copper-free” aluminum, neoprene gasketed covers fastened with stainless steel screws, rain-tight, suitable for wet locations, Crouse-Hinds, Appleton or O-Z Gedney Form 35, Form 8, Mark 9, or Mogul. Die-cast aluminum types are not acceptable.
- B. **Conduit bodies installed outdoors shall have cast :copper-free” aluminum or stainless steel gasketed covers fastened with stainless steel screws. (ADDENDUM 2, 11/7/25)**
- C. Conduit body cover screws shall thread directly into the conduit body. Conduit body covers with wedge-clamp type covers are not acceptable.
- D. Conduit body hub configuration shall be as required based on conduit routing for the cover to be readily accessible for easy removal.
- E. 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.
- F. The maximum number of conductors shall be computed in accordance with NEC Article 314-16(C).

2.7 CONDUIT MOUNTING CLAMPS

- A. Conduit mounting clamps for securing conduits inside buildings shall be galvanized steel one-hole, two-hole or H-Type (mini’s). Conduit mounting clamps used outdoors shall be Type 304 stainless steel.
- 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 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 by Unistrut Corporation or Kindorf Electrical Products, Co.

2.8 FIRE-STOPPING MATERIALS

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

7. General Electric GE RTV850 or GE RTV6428
8. Chase Technology Corporation CTC PR-855 fire-resistant silicone foam

2.9 INTUMESCENT SILICONE SEALANT

- A. Intumescent silicone sealant shall meet UL Water Leakage Test – Class 1 requirements and shall be re-enterable and repairable; 3M Fire Barrier Water Tight Silicone Sealant 3000WT or Designer approved equal.
- B. Fire barrier packing material for use with 3M UL listed 3000WT intumescent silicone sealant shall be 6 psf mineral wool, 3M Fire Barrier Packing Material PM4 or Designer approved equal.

2.10 CONDUIT PULL STRING

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

2.11 PROTECTIVE COATING FOR DIRECT BURIED METAL CONDUIT

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

2.12 UNDERGROUND CONDUIT WARNING TAPE

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

CAUTION BURIED ELECTRIC LINE BELOW

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

2.13 CONDUIT/DUCT PLUGS

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

PART 3 - EXECUTION

3.1 INSTALLATION

- A. CONDUIT

Upgrade Generator Controls & Transfer Switch, Power Plant
Moberly Correctional Center, Moberly, Missouri

C1920-01

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. **Conduit bends for conduits containing medium-voltage cables shall have a minimum radius of 24-inches. (ADDENDUM 2, 11/7/25)**
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 9'-0" 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 9 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, motor control center, switchgear, automatic transfer switch, generator connection cabinet or transformer, shall terminate 2 inches above the bottom of the enclosure or top of concrete equipment pad on which the enclosure stands. If the conduit is rigid galvanized steel, provide an insulated grounding bushing on the end of the 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.

B. CONDUIT EXPANSION FITTINGS (ADDENDUM 2, 11/7/25)

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

C. CONDUIT SEALING BUSHINGS

1. Provide internal conduit sealing bushings at all electrical enclosures where a conduit is exposed to widely different temperatures, or where an underground conduit enters a building horizontally below grade to prevent condensation or moisture inside the conduit from entering the enclosure.
2. For conduit/conductor arrangements for which a factory drilled conduit sealing bushing is not available, seal the inside of the conduit, around the conductors or

cables, at the first conduit body or enclosure inside each building using an intumescent silicone sealant.

3. Provide external conduit sealing bushings at all conduits entering a building through a concrete or masonry wall. Sealing devices shall be installed such that all bolts in the sealing bushing or link seal are accessible
4. Install an internal conduit sealing bushing in the end of a duct or conduit that enters the bottom of a grade mounted switchgear, generator connection cabinet or neutral grounding resistor to seal around the conductors/cables and prevent vermin from entering the conduit. Do not seal around cables/conductors in conduits with expandable foam sealant or other non-approved sealing products.

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 shall not 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, and ceilings 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 or ceilings 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 through interior walls, floors and ceilings 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. DIRECT BURIED 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. 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.
6. Backfill for trenches containing direct buried conduit shall be in accordance with Section 310000 – Earthwork. Any settlement shall be corrected by refilling and retamping. No puddling will be permitted.
7. Underground conduits shall be at least 12 inches away from gas, water or other pipe lines.
8. Conduits shall have long swept elbows.
 - a. Size 2" and below – 24" minimum radius
 - b. Size 2-1/2" and above – 36" minimum radius
9. Factory elbows for conduit sizes 2 inches and larger shall be rigid galvanized steel Schedule 40 with corrosion protection applied as specified herein.
10. Couplings for conduits in a common trench shall be staggered at least 6 inches. All joints shall have watertight seals.
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.

H. UNDERGROUND CONDUIT WARNING TAPE

1. Unless otherwise indicated, the location of all directly buried conduits shall be marked by burying one a warning tape below grade in the backfill. The warning tape shall be placed 18 inches above the top of the conduit(s) and shall be parallel along the full length of the run. Where the top of the conduit(s) 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).
2. 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 263213.16 – DIESEL-ENGINE-DRIVEN GENERATOR SET CONTROLS

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 upgrade an existing diesel engine-generator set with electro-mechanical control system, with the necessary microprocessor based electronic controls, including all appurtenances, as specified herein and as shown on the Drawings, to provide 10-second automatic start and operation of the generator to provide emergency power for the Moberly Correctional Center in Moberly, Missouri.

1.3 RELATED SECTIONS

- A. Section 230900 – Instrumentation and Control for HVAC
- B. Section 231330 – Fuel Oil Day Tank – Diesel Engine Driven Generator
- C. Section 233313.13 – Volume-Control Dampers
- D. Section 233423 – HVAC Power Ventilators
- E. Section 235750 – Remote Radiator – Diesel Engine Driven Generator
- F. Section 260500 – Common Work Results for Electrical
- G. Section 260526 – Grounding and Bonding for Electrical Systems
- H. Section 260529 – Hangers and Supports for Electrical Equipment
- I. Section 260553 – Identification for Electrical Systems
- J. Section 261350 – Neutral Grounding Resistor
- K. Section 263290 – Medium-Voltage Generator Connection Cabinet
- L. Section 263623 - Medium-Voltage Automatic Transfer Switch

1.4 SECTION INCLUDES

- A. The work covered under this section shall include, but not be limited to, the following items:
 - 1. Generator control panel
 - 2. Remote annunciator panel
 - 3. Three (3) “ship loose” remote emergency stop push button and enclosure assemblies

4. Computer interface module to allow control and monitoring of engine-generator set from Owner's existing Schneider Electric StruxureWare building automation system
5. Diesel fuel for startup and operation of engine-generator set prior to substantial completion of the project
6. Temporary diesel-engine-driven generator and 480V-4.16Y/2.4kV, 3-phase step-up transformer, if the provided generator is 480Y/277V, 3-Phase in lieu of 4.16Y/2.4kV, 3-phase to provide standby emergency power for the facility at all times when the existing emergency system is out of service.
7. On site startup and load testing of the engine-generator control system
8. On site Owner training on the engine-generator control system
9. Air permit determination
10. Fuel spill prevention, control and countermeasures plan

1.5 SUBMITTALS

- A. Submit shop drawings and product data in accordance with the requirements of Section 260500 – Common Work Results for Electrical.
- B. Shop drawings shall be submitted for approval prior to release of the equipment for manufacturing and shall include, but not be limited to, the following:
 1. Factory published specification sheet indicating standard and optional accessories, ratings, for the control equipment.
 2. Breakdown of all components and options to be included
 3. Product data showing interconnection points and internal wiring diagrams for generator control panel, battery charger, day tank, remote radiator fan motor starter, generator room ventilation equipment and remote annunciator
 4. **Manufacturer's product data sheets for electronic generator and, if required, electro-hydraulic actuator. (ADDENDUM 2, 11/7/25)**
 5. Control panel and remote annunciator dimensioned outline drawings (plans and elevations) showing overall measurements, mounting provisions, and interconnect points for electrical connections.
 6. Interconnecting wiring diagrams and schematics for complete emergency system, including generator, medium-voltage automatic transfer switch, day tank, battery charger, medium-voltage generator connection cabinet, fuel system, cooling system and remote alarm indications and remote computer interface. These drawings shall be specific to the project requirements and provided by Fabick Power Systems in conjunction with Caterpillar. Factory drawings that provide multiple interconnections for items not specific to the project will be rejected.
 7. Control panel schematics
 8. Field wiring diagrams indicating all necessary wiring to from remote systems and devices to the new generator control panel.
 9. Manufacturer's and dealer's written warranty disclosure statement for the period specified.

10. Location and description of supplier's parts and service facility within a three (3) hour drive time of the jobsite, including parts inventory, number of qualified technicians and service vehicles, normal and emergency telephone numbers and contact person.
- C. Fabick Power Systems shall provide copies of field technician's factory training certificates specific to the proposed generator set controls upgrade in order to verify the level of support capabilities. Delegation of this service responsibility for any of the equipment listed herein will not be considered fulfillment of these specifications. Major engine and control parts shall be available within 24 hours from the time a component is deemed defective.
 - D. Submit startup and commissioning test reports including full-load resistive load bank test report.
 - E. Installation, Operation & Maintenance Manuals: Provide IO&M Manuals that describe installation, operation, and maintenance of the equipment in compliance with Section 017823 – Operation and Maintenance Data and Section 007213 – General Conditions and Section 260500 – Common Work Results for Electrical.
 - F. O & M Manuals shall be provided as follows:
 1. Submit three (3) sets of manuals bound in 8-1/2 inch by 11-inch (A4) text pages, except drawings reduced to 11-inch by 17-inch pages may be folded for inclusion in the manuals. The manuals shall be provided in electronic (.pdf) format. Upload the PDF file to the Missouri OA FMDC project management website, Trimble (fka eBuilder).
 2. Each hard copy of the manuals shall be assembled and bound into hard-back, post-type binders suitable for rough usage. Three-ring, snap-ring type binders are not acceptable.
 3. Prepare binder cover and spline inserts with printed title, "OPERATION AND MAINTENANCE INSTRUCTIONS FOR PACKAGED ENGINE-GENERATOR CONTROL SYSTEM", title of project, project number, and subject matter of binder when multiple binders are required.
 4. Internally subdivide binder contents with permanent page dividers, logically organized as described below, with tab titling clearly printed under reinforced, laminated, plastic tabs.
 5. Operation and maintenance manuals shall include:
 - a. Table of contents
 - b. Appropriate design criteria
 - c. List of equipment
 - d. Parts list for each component
 - e. Operating instructions
 - f. Maintenance instructions for equipment and systems
 - g. Shop drawings and product data
 - h. Photocopies of warranties
 - i. Test reports

- j. Manufacturer's detailed instructions for start-up, shutdown, operation and maintenance, including drawings, wiring diagrams and schematics for the engine, generator, remote radiator and day tank
 - k. Bill of materials and manuals/data sheets for individual components
 - l. Manufacturer's recommended spare parts list
 - m. Manufacturer's recommended preventive maintenance schedule
 - n. Oil sampling and analysis for engine wear
 - o. Emergency maintenance procedures
- G. Manuals shall be conformed to "as-built" status by incorporating any and all changes made during the start-up period.

1.6 REFERENCES

- A. The equipment covered by this section of the Specifications shall be designed, assembled and tested in accordance with the latest applicable ANSI, NEMA, UL, NFPA and EPA Standards, including, but not limited to:
 - 1. ANSI/NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum)
 - 2. ANSI/NEMA MG 1 Motors and Generators
 - 3. ANSI/NFPA 70 National Electrical Code
 - 4. ANSI/NEMA AB 1 Molded Case Circuit Breakers
 - 5. NFPA 30 – Flammable and Combustible Liquid Code
 - 6. NFPA 37 – Installation and Use of Stationary Combustion Engines and Gas Turbines
 - 7. NFPA 110 – Emergency and Standby Power Systems
 - 8. UL 142 – Steel Above Ground Tanks for Combustible Liquids
 - 9. UL 2200 – Stationary Engine Generator Assemblies
 - 10. Environmental Protection Agency EPA Emission Standards for Compressed Ignition Engines

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver to project site and store and protect products at the project site in accordance with the provisions of Section 260500 – Common Work Results for Electrical.
- B. Accept all equipment on site and document any and all damage upon receipt at the project site.

1.8 PROJECT RECORD DOCUMENTS

- A. Submit record documents in accordance with the requirements of Section 260500 – Common Work Results for Electrical.
- B. Accurately update all control submittal items to reflect the "as-built" conditions and issue a "FOR RECORD" revision to all applicable documents.

1.9 QUALIFICATIONS

- A. *Manufacturer:* Caterpillar (manufacturer of existing CAT 3516 diesel-engine-driven generator that is being upgraded with new electronic controls).
- B. *Supplier:* Fabick Power Systems division of Fabick CAT, who provided field service for modifications to the engine on the existing CAT 3516 diesel-engine-generator to re-rate it from 1300kW continuous duty to 1450kW standby duty in September 2020, shall be the sole-source provider for all work specified in this Section. Contact information:
1. Chris Zahari, Account Manager
Fabick Power Systems
101 Fabick Dr.
Fenton, MO 63026
314-412-0003
christopher.zahari@fabick.com christopher.zahari@fabickcat.com
(ADDENDUM 1, 10/30/25)
 2. Mark Schellert, Product Support Representative
Fabick Power Systems
101 Fabick Dr.
Fenton, MO 63026
314-791-3915
mark.schellert@fabick.com mark.schellert@fabickcat.com
(ADDENDUM 1, 10/30/25)

1.10 WARRANTY

- A. The standby engine-generator control system be warranted by the manufacturer against defective materials and factory workmanship for a period of 2 years after the date of substantial completion. Any and all defective parts shall be repaired or replaced at the manufacturer's option, free of charge including travel and labor during the term of the warranty.
- B. The Owner shall be allowed to perform his own preventive maintenance on the unit during the warranty period without voiding the warranty. The Owner will keep a log of all maintenance on the unit to certify compliance with the engine-generator manufacturer's requirements as published in the O&M Manuals.
- C. Satisfactory warranty documents must be provided. Authorized distributor shall provide copies of factory authorization warranty repair certificates specific to the proposed product on electrical systems control repair in order to verify the level of support capabilities. Delegation of this service responsibility for any of the equipment listed herein will not be considered fulfillment of these specifications. Also, in the judgment of the specifying authority, the manufacturer supplying the warranty for the complete system must have the necessary financial strength and technical expertise with all components supplied to provide adequate warranty support.

PART 2 - PRODUCTS

2.1 GENERAL

- A. The existing packaged diesel-engine-driven generator set is a Caterpillar 3516, 4,160Y/2,400 V, 3-phase, 4-wire, 60 Hz, ~~4,4500~~ **1,450 (ADDENDUM 2, 11/7/25) kW**

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standby duty unit that was installed in 1986 inside the Power Plant at the Moberly Correctional Center in Moberly, Missouri. The engine is liquid cooled with an outdoor, remote radiator that is mounted on grade just outside the generator room. The fuel injectors were replaced on the engine and the engine was retuned by a Caterpillar factory authorized service technician from the Fabick Power Systems division of Fabick CAT, Fenton, Missouri in September 2020 under a contract with CK Power Systems, St. Louis, Missouri to re-rate the generator set from an output of 1,300 kW continuous to 1,450 kW standby.

- B. After the modifications to the engine to re-rate the unit from continuous to standby duty a full load test using a resistive load bank was conducted but was aborted prematurely due to the unit beginning to show signs of overheating. The engine cooling and generator room ventilation systems are to be replaced under this project, see Division 23 specifications, to allow the unit to produce full rated output power.
- C. The CK Power Systems inspection report and close-out report, after all contracted work was completed, are included in Attachment 1 to this specification section for reference.
- D. All new equipment and materials shall be new, and where applicable, shall bear the Underwriters' Laboratories, Inc. (U.L.) Label of Approval. The electric generator shall be UL Listed and Labeled.
- E. Furnish a complete and coordinated control system which provides all necessary interfaces between the diesel engine-generator, and the generator auxiliaries. All necessary switches, starters, contactors, and overloads required for the generator auxiliaries shall be furnished.
- F. The diesel engine-generator set control system shall meet the following requirements:
 - 1. The rated output voltage of 4,160 volts (line-to-line) shall have a manual adjustment of $\pm 5\%$.
 - 2. Voltage regulation shall not exceed $\pm 0.5\%$.
 - 3. Voltage steady-load bandwidth shall not exceed $\pm 1\%$.
 - 4. The voltage transient performance:
 - a. Dip, with step application of 25% load, shall not exceed 5%.
 - b. Rise, with step removal of 25% load, shall not exceed 5%.
 - c. Recovery time shall not exceed 1.5 seconds.
 - 5. The frequency shall be manually adjustable from 56 to 64 Hz.
 - 6. The frequency steady-load operational bandwidth shall not exceed $\pm 0.5\%$ of rated frequency from no load to full load.
 - 7. The frequency transient performance:
 - a. Dip, with step application of 25% load, shall not exceed 3.6 Hz.
 - b. Rise, with step removal of 25% load, shall not exceed 3.6 Hz.
 - c. Recovery time shall not exceed 2 seconds.
- G. The diesel engine-generator control system shall consist of the following major components:
 - 1. Existing Caterpillar 3516 diesel-engine-driven generator
 - 2. New Caterpillar ECS100 generator controller

3. **New Woodward 2301E electronic governor and, if required, electro-hydraulic actuator (ADDENDUM 2, 11/7/25)**
 4. **Voltage regulator salvaged from the existing generator control panel (ADDENDUM 2, 11/7/25)**
 5. Control interfaces to new remote radiator with fan under Section 235750 – Remote Radiator-Diesel Engine Driven Generator
 6. Existing 24VDC batteries and battery charger
 7. Control interfaces to new fuel oil day tank under Section 231330 – Fuel Oil Day Tank-Diesel Engine Drive Generator
 8. Control interfaces to new fuel transfer (between new day tank and existing diesel-engine-driven generator) system
 9. Control interfaces to new generator room ventilation system under Section 233313.13 – Volume-Control Dampers and Section 233423 – HVAC Power Ventilators
 10. Control interfaces to the new medium-voltage automatic transfer switch under Section 263623 – Medium-Voltage Automatic Transfer Switches.
 11. Control interfaces to the new medium-voltage generator connection cabinet under Section 263290 – Medium-Voltage Generator Connection Cabinet.
 12. Control interfaces to the existing building automation system (BAS) under Section 230900 – Instrumentation and Control for HVAC
 13. Control interface to new emergency generator remote radiator cooling water flow transmitter
 14. New remote annunciator
 15. New remote computer interface
 16. New remote emergency stop push buttons and enclosures
- H. Fabick Power Systems and Caterpillar shall design the controls for the entire emergency system, which shall encompass the existing diesel-electric generator set and the new generator control panel.
- I. Fabick Power Systems shall assume full responsibility for the coordination of all control wiring design between the components of the emergency system, and shall provide whatever interface components and contacts necessary to achieve this.
- J. Fabick Power Systems shall provide field technicians and supervision as required to ensure successful implementation of the generator control system retrofit.

2.2 THEORY OF OPERATION

- A. The automatic transferring of the Moberly Correctional Center loads from the normal power source to the emergency generator power source shall be accomplished by means of a new medium-voltage closed-transition automatic transfer switch unit specified under Section 263623 – Medium-Voltage Automatic Transfer Switch (MVATS).
- B. The mode of operation shall be determined by the position of the Engine Control Switch (ECS) located on the Generator Control Panel. The ECS shall be a three-position selector

switch having maintained contacts. The three (3) positions shall be (1) AUTOMATIC, (2) MANUAL, and (3) OFF.

- C. The following shall be the sequence of events when the Engine Control Switch is in the AUTOMATIC position:
 - 1. When any phase of the normal power source fails or drops below 70% of the rated voltage, the automatic transfer time delay “on” starting relay (“on delay” set for 3 seconds) located inside each of the source-transfer switchgear units shall be energized. When the time delay relay times out, the relay contact shall close, starting the emergency generator. When the generator reaches rated voltage and frequency, the medium voltage source-transfer switches shall automatically transfer the load from the normal (utility) source to the emergency generator (emergency) source.
 - 2. Upon restoration of normal power (when the normal voltage is greater than 90% of rated voltage in all three phases), the source-transfer switchgear units shall, after a time delay (set for 10 minutes), automatically retransfer the load back to normal power source. Then after an additional time delay (normally about 5 to 10 minutes) shall shut down the engine-generator set. Drop out and pick up voltages shall be factory calibrated.
- D. The following shall be the sequence of events when the Engine Control Switch is in the MANUAL position:
 - 1. The engine-generator set will automatically start immediately and come up to rated voltage and frequency. The engine-generator set shall then be manually controlled and shall continue to operate until the Engine Control Switch is turned to OFF.
- E. The OFF position of the Engine Control Switch shall shut down the engine-generator set at the end of the cool-down time period.
- F. The Generator Control Panel shall include a red mushroom head EMERGENCY STOP push button that, when depressed, shall do the following:
 - 1. Trip the emergency source (generator) circuit breaker in the MVATS and shut down the engine-generator set immediately without a cool-down time period.
 - 2. **Three (3) additional EMERGENCY STOP push buttons that when depressed, shall each perform this same function:**
 - a. **Two (2) mounted in generator room adjacent to each of the two (2) egress doors as indicated on the Drawings.**
 - b. **One (1) mounted remotely next to the generator annunciator in the Power Plant office as indicated on the Drawings.**

(ADDENDUM 2, 11/7/25)

2.3 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with all requirements specified herein, provide products by Caterpillar and Fabick Power Systems as indicated under Article 1,9 – Qualifications herein.

2.4 GENERATOR CONTROL PANEL

Upgrade Generator Controls & Transfer Switch, Power Plant
Moberly Correctional Center, Moberly, Missouri

C1920-01

- A. A local Generator Control Panel shall be provided for complete control and monitoring of the existing CAT 3516 engine-generator set. The control panel shall be housed in a NEMA Type 12, surface mounted, dead front, 14-gauge (minimum) steel enclosure mounted on a floor mounted U-channel support rack next to the engine-generator set. Critical components shall be environmentally sealed to protect against failure from moisture and dirt.
- B. The Generator Control Panel shall include, but shall not be limited to, the following items/features:
 1. Automatic start/stop operation of engine-generator set by means of a complete 2-wire automatic engine start-stop control which starts the engine on closing contacts and stops the engine on opening of the contacts.
 2. Cyclic cranking limiter with crank and rest cycles, individually adjustable shall be provided to open the starting circuit after eight attempts if the engine has not started within that time.
 3. Adjustable cooldown timer **(It is acceptable for this function to be performed by the new closed-transition automatic transfer switch per Section 263623 – Medium-Voltage Automatic Transfer Switches.) (ADDENDUM 2, 11/7/25)**
 4. Emergency Stop push button
 5. Three (3) position AUTO / MANUAL / OFF Engine Control Switch (ECS)
 6. True RMS sensing digital AC metering (0.5% true RMS accuracy) with phase selector switch
 - a. Generator output alternating current (AC) voltage (L-L)
 - b. Generator output alternating current (AC) voltage (L-N)
 - c. Generator output alternating current (AC) amperes
 - d. Generator frequency, accuracy ± 0.195 hertz
 - e. Generator output kilowatts (kW) – Total and per phase
 - f. Generator output kilovolt-amperes (kVA) – Total and per phase
 - g. Generator output kilovolt-amperes-reactive (kVAR) – Total and per phase
 - h. Generator output power factor – Overall and per phase
 - i. Generator output percentage of rated power output
 - j. Generator output kilowatt-hours (kWhr)
 - k. Generator output kilovolt-ampere-hours (kVAhr)
 - l. Generator output kilovolt-ampere-reactive-hours (kVARhr)
 7. Digital engine monitoring
 - a. Lubrication oil pressure
 - b. Coolant temperature
 - c. Revolutions-per-minute (RPM)
 - d. Running time (hours)
 - e. Engine successful start counter
 - f. Engine crank attempt counter

- g. Service maintenance interval
 - h. Fuel consumption (gal/hr)
 - i. Total fuel consumed (gal)
 - j. Air filter differential pressure
 - k. Boost pressure
 - l. Engine crankcase pressure
 - m. Engine exhaust temperature (left and right)
 - n. Engine intake manifold temperature
 - o. Engine oil temperature
 - p. Fuel filter differential pressure
 - q. Fuel pressure
 - r. Oil filter differential pressure
 - s. Oil temperature
8. Digital display of system direct current (DC) voltage
 9. **Automatic voltage regulator salvaged from the existing generator control panel (ADDENDUM 2, 11/7/25)**
 10. Generator voltage adjustment potentiometer for the voltage regulator
 11. **Woodward 2301E electronic, speed sensing isochronous governor ~~isochronous~~ for engine speed control. The engine governor shall maintain isochronous frequency regulation from no load to full rated load with hydraulic or hydro-electronic actuation. Steady-state operating band shall be $\pm 0.25\%$. The governor shall be capable of remote speed adjustment. The moving parts of the governor shall be automatically lubricated. If the existing CAT 3516 diesel-engine-driven generator set requires a new electro-hydraulic actuator for operation with the new electronic governor, a Woodward EG Series or approved equal electro-hydraulic actuator shall be provided. The actuator shall be sized by Fabick Power Systems based on the work output required. (ADDENDUM 2, 11/7/25)**
 12. **The engine, generator, regulator, and governor combination shall permit FULL RATED BLOCK LOAD application with speed and voltage recovery within six seconds after full load application. (ADDENDUM 2, 11/7/25)**
 13. Frequency control
 14. Engine run (ER) relay with 120 VAC, 10-amp Form "C" contacts that change state when the engine is running
 15. Engine run auxiliary relay with three (3) sets of 120 VAC, 10-amp, Form "C" contacts brought out to terminal strips. The relay shall operate on generator start and run.
 16. Common fault relay with 120VAC, 10-amp Form "C" dry contacts that change state for a generator fault condition shall be provided for customer use.
 17. 120VAC, 10-amp dry contact for interlocking with the building intake and exhaust louver actuators such that the contact opens upon generator start command to cause the louvers to open.

18. **Provide a Local Generator Annunciator Panel in compliance with NFPA 110 for a Level 2 system with LED indicating lights and 24 VDC alarm horn. Include the listed pre-alarm and alarm points, audible alarm, alarm silencing means, repetitive alarm circuitry, and lamp test switch in a NEMA Type 1 or 12 painted steel enclosure. Provide all required sensors and contacts to annunciate both visually and audibly the following at the local generator annunciator panel and on the generator control panel human machine interface (HMI) touchscreen:**
- a. **Overcrank Shutdown**
 - b. **Low Water Temperature Alarm**
 - c. **High Engine Temperature Pre-alarm and Shutdown**
 - d. **Low Lube Oil Pressure Pre-alarm and Shutdown**
 - e. **Overspeed Shutdown**
 - f. **Low Fuel Day Tank Alarm**
 - g. **Low Coolant Level Alarm**
 - h. **EPS Supplying Load**
 - i. **Control Switch Not in Auto Alarm**
 - j. **High Battery Voltage Alarm**
 - k. **Low Cranking Voltage Alarm**
 - l. **Low Battery Voltage Alarm**
 - m. **Battery Charger Failure Alarm (includes AC failure)**
 - n. **Emergency Stop**
 - o. **Overload Alarm**
 - p. **Common Alarm (Activates on all alarms that are displayed on the generator control panel HMI touchscreen but not on the local annunciator.)**
 - q. **LEDs for shutdown alarms shall be red.**
 - r. **LEDs for alarms that do not cause a shutdown shall be yellow or amber.**
 - s. **LEDs for informational alarms, such as “EPS Supplying Load”, shall be green.**

(ADDENDUM 2, 11/7/25)

19. ~~Sensors and individual LED pilot lights and 24 VDC alarm horn~~ **Provide all required sensors and contacts to annunciate both visually and audibly the following on the generator control panel. In addition to the above alarms, the following alarms shall be annunciated/displayed at the generator control panel HMI touchscreen and shall light the “Common Alarm” on the generator local annunciator panel:**
- a. **Generator run status**
 - b. ~~Lubrication Oil Low Pressure Alarm~~
 - c. ~~Lubrication Oil Low Pressure Shutdown~~

- d. Lubrication Oil High Temperature Alarm
- e. ~~Engine Low~~ **Lubrication Oil High** Temperature Alarm **Shutdown**
- f. ~~Engine High Temperature Alarm~~
- g. ~~Engine High Temperature Shutdown~~
- h. ~~Engine Overcrank Shutdown~~
- i. ~~Engine Overspeed Shutdown~~
- j. ~~Control Switch Not In Auto~~
- k. ~~Battery Charger Failure Alarm~~
- l. ~~Low DC Voltage Alarm~~
- m. ~~High DC Voltage Alarm~~
- n. ~~Low Coolant Level Alarm~~
- o. Generator Breaker ~~Open~~ **Closed**
- p. ~~Emergency Stop Activated~~
- q. ~~Over Voltage~~ **Overvoltage** Alarm
- r. ~~Under Voltage~~ **Undervoltage** Alarm
- s. ~~Over Frequency~~ **Overfrequency** Alarm
- t. ~~Under Frequency~~ **Underfrequency** Alarm
- u. ~~Overcurrent Alarm~~
- v. Reverse Power Alarm
- w. Low Fuel Pressure Alarm
- x. Low Fuel Pressure Shutdown
- y. High Fuel Pressure Alarm
- z. High Fuel Pressure Shutdown
- aa. Fuel Filter Restriction Alarm
- bb. Fuel Filter Restriction Shutdown
- cc. High Intake Manifold Air Temperature Alarm
- dd. High Intake Manifold Air Temperature Shutdown
- ee. Low Fuel ~~Supply~~ **Main Tank** Alarm
- ff. Fuel **Day** Tank Leak Alarm
- gg. **High** Fuel **Day** Tank ~~High Level~~ Alarm
- hh. **Day Tank Reverse Pump Running Status**
- ii. **Day Tank Control System Fault Alarm**
- jj. **Low Coolant Flow Alarm**

(ADDENDUM 2, 11/7/25)

- 20. Audible alarm, 24 volts DC, flush mounted, 101 dB(A) at 10 feet; Edwards Type 871-G1, or approved equal

21. Alarm Acknowledge/Horn Silence push button
 22. LAMP TEST push button for testing lamps in all of the pilot and annunciator lights on the control panel door, as well as the audible alarm
 23. Main thermal-magnetic circuit breaker to disconnect all power within the control panel
 - ~~24. Automatic voltage regulator specified elsewhere in this Section
(ADDENDUM 2, 11/7/25)~~
 - ~~25. Isochronous electronic governor speed control specified elsewhere in this Section
(ADDENDUM 2, 11/7/25)~~
- C. An overspeed device shall be provided for the unit separate from the governor to automatically stop the engine should the speed exceed 115-120% of rated speed. The overspeed trip shall be immediate in action and shall be of a type which must be reset by hand. An emergency shutdown device shall be incorporated with the overspeed trip. The generator main circuit breaker shall trip "open" when this device is activated.
 - D. All adjustments used for regulating the voltage, speed, fuel, cooling water, lubricating oil pressure and such parts shall be shock mounted.
 - E. The control panel shall incorporate self-diagnostics capabilities and fault logging.
 - F. The control panel shall have ~~digital LCD~~ **a HMI touchscreen display** indication and LED indicating lights, for alarms and pre-alarms. The control panel shall have ~~"key pad"~~ **touchscreen** programmability and shall have a backup means for the program, EPROM or long life lithium battery, such that the system memory and program data is not lost in the event of a control power (engine starting battery) failure.
 - G. Control panel shall be suitable for operation in a 20°F to 120°F, 0 to 100% relative humidity environment.
 - H. The emergency generator control panel shall include an interface which communicates with the Owner's **existing** Building Automation System (BAS) using ~~either a~~ **an Ethernet Modbus TCP/IP or Modbus RTU** protocol.
 - I. Fabick Power Systems shall coordinate with the Owner's BAS integrator, which shall be C&C Group (Corey Schepers, 919-530-7369, cschepers@c-cgroup.com).
 - J. Fabick Power Systems shall provide the necessary information to C&C Group to provide proper integration of emergency system controls and alarms into the existing Schneider Electric StruxureWare BAS.
 - K. **The generator controller shall be Caterpillar Model ECS100.**

2.5 REMOTE ANNUNCIATOR

- A. Provide a Remote Engine Annunciator Panel **(or two if required to accommodate all of the required alarm points indicated below)** in compliance with NFPA 110 for a Level 2 system with LED indicating lights and 24 VDC alarm horn. Include the listed pre-alarm and alarm points, audible alarm, alarm silencing means, repetitive alarm circuitry, and lamp test switch in a ~~flush surface~~ **mounted NEMA 1 or NEMA 12 painted steel** panel with ~~brushed stainless steel finish~~ **faceplate that does not extend beyond the edges of the**

enclosure. Provide all interconnecting wiring in conduit per manufacturer's requirements by the Electrical Contractor. The remotely reported alarms shall include the following:

1. Generator Running
2. Emergency Power Supply (EPS) Supplying Load
3. Emergency Stop / Emergency Power Off (EPO) Switch Activated
4. Generator Breaker ~~Open~~ **Closed**
5. Control Switch Not In Auto
6. Lubrication Oil Low Pressure Alarm
7. Lubrication Oil Low Pressure Shutdown
8. ~~Engine~~ High **Engine** Temperature Alarm
9. ~~Engine~~ High **Engine** Temperature Shutdown
10. ~~Engine~~ Low **Water** Temperature Alarm
11. Low Coolant Level Alarm
12. Engine Overcrank Shutdown
13. Engine Overspeed Shutdown
14. Battery Charger Failure Alarm (includes AC failure)
15. High Battery Voltage Alarm
16. Low Battery Voltage Alarm
17. Low Fuel Main Tank Alarm
18. Low Fuel Day Tank Alarm
19. High Fuel Day Tank Alarm
20. Fuel ~~Oil~~ **Day** Tank Leak Alarm
21. Day Tank ~~Pumps~~ **Reverse Pump** Running Status
22. Day Tank Control System Fault Alarm
23. **High Oil Temperature Alarm**
24. **High Oil Temperature Shutdown**
25. **Undervoltage Alarm**
26. **Overvoltage Alarm**
27. **Underfrequency Alarm**
28. **Overfrequency Alarm**
29. **Overload Alarm**
30. **High Intake Manifold Air Temperature Alarm**
31. **High Intake Manifold Air Temperature Shutdown**
32. **Low Cranking Voltage Alarm**
33. **Low Coolant Flow Alarm**
34. **Common Alarm (Activates on all alarms that are displayed on the generator control panel HMI touchscreen but not on the remote annunciator.)**

- 35. LEDs for shutdown alarms shall be red.**
- 36. LEDs for alarms that do not cause a shutdown shall be yellow or amber.**
- 37. LEDs for informational alarms, such as “EPS Supplying Load”, shall be green.**

(ADDENDUM 2, 11/7/25)

- B. Audible alarm shall be 24 volts DC, flush mounted, 101 dB(A) at 10 feet; Edwards Type 871-G1 or approved equal.
- C. Provide Alarm Acknowledge/Horn Silence push button.
- D. Provide Lamp Test push button for testing all indicator lights on the remote annunciator.
- E. The remote annunciator shall interface to the General Control Panel specified elsewhere in this Section. Any required relay contacts to activate the alarms on the remote annunciator shall be provided.
- F. The remote annunciator modules shall be environmentally sealed and housed in a NEMA 1 or NEMA 12 enclosure for surface mounting.
- G. All inputs and outputs shall be protected against short circuits to (+/-) battery and shall have reverse polarity protection.
- H. The remote annunciator shall be suitable for operation in a 20°F to 120°F, 0 to 100% relative humidity environment.

2.6 ACCESSORIES

- A. Remote Manual Stop Stations (Emergency Power Off – EPO): Provide three (3) red, mushroom head, maintained contact type emergency power off (EPO) push buttons in a NEMA Type 12 or 13 stainless steel or painted, cast aluminum control enclosure for emergency shutdown of the generator.
 - 1. Two (2) mounted in generator room adjacent to each of the two (2) egress doors as indicated on the Drawings
 - 2. One (1) mounted remotely next to the generator annunciator in the Power Plant office as indicated on the Drawings
 - 3. Push buttons shall be of the same type and design as the EPO push button mounted in the new Generator Control Panel.
- B. The new generator control panel shall provide automatic monitoring of the EPO switches. All generator EPOs shall be field wired to the Generator Control Panel such that activation of any of the EPO push buttons shall shut down the engine-generator immediately without a cool-down time period, trip the emergency source (generator) circuit breaker located in the new MVATS open, and initiate a visual and audible alarm at each generator annunciator panel and the remote generator annunciator panel.
- C. Provide an engraved laminated plastic nameplate on all generator EPO push button enclosures with 1/4-inch high engraved white characters on a red background with the following wording:

GENERATOR

Upgrade Generator Controls & Transfer Switch, Power Plant
Moberly Correctional Center, Moberly, Missouri

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2.7 FACTORY TESTS

- A. The generator control panel manufacturer shall perform all standard tests as required by UL, after the fabrication is complete and the panel shall have a UL label applied prior to shipment from the factory.

2.8 EXTRA MATERIALS

- A. Provide five (5) spare indicator lamps of each size and type used I the control panel (if applicable)
- B. Provide three (3) spare control fuses of each size and type used in the control panel.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces are ready to receive work and field dimensions are as shown on the drawings.
- B. Verify that required utilities are available in proper location and ready for use.
- C. Beginning of installation means installer accepts existing conditions.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions and referenced standards.
- B. Install “shipped loose” items in accordance with the engine-generator manufacturer’s written instructions and as indicated on the Drawings.
- C. Provide conduit and wiring/cabling in accordance with the engine-generator manufacturer’s written instructions and as indicated on the Drawings to connect the various components of the emergency power system together to make a complete and functioning system.
- D. Install remote EPO stations in locations shown on the Drawings. Provide 24V DC power wiring and communications cable in conduit as required. Coordinate installation with the manufacturer approved shop drawings and wiring diagrams.

3.3 START-UP SERVICES

- A. Field inspection and testing will be performed under provisions of Section 260500 – Common Work Results for Electrical and in compliance with NFPA 37 and NFPA 110 requirements.
- B. Fabick Power Systems shall include the services of factory authorized field technician(s) for the following:
 - 1. Verify that all equipment is installed properly
 - 2. Check all auxiliary devices for proper operation including battery charger, jacket water heater(s), generator anti-condensation heater, generator control panel,

remote annunciator, remote computer interface, remote radiator fan, day tank, generator room ventilation system, etc.

3. Test all alarms and safety shutdown devices for proper operation and annunciation
 4. Check all fluid levels
 5. Start engine and check for exhaust, oil and fuel leaks, vibrations, etc.
 6. Verify proper voltage and phase rotation at ~~each medium-voltage source-transfer pad-mounted switchgear unit~~ **the medium-voltage closed-transition automatic transfer switch** before ~~connecting to the load~~ **energization. (ADDENDUM 2, 11/7/25)**
- C. Prior to any testing, and before starting the diesel engine, the Fabick Power Systems factory authorized service representative shall perform the following:
1. Fuel, lubricating oil, and antifreeze shall be checked for conformity to the manufacturer's recommendations under the environmental conditions present and expected.
 2. Accessories that normally function while the set is in standby shall be checked prior to cranking the engine. This shall include, but not be limited to, engine jacket water heater(s), battery charger, and generator anti-condensation heater.
 3. Tests shall be made to check for exhaust leaks, cooling air flow, movement during starting and stopping, vibration during running, normal and emergency line-to-line voltage, and phase rotation.
 4. Prior to the electrical loading of the generator set, the controls shall be tested for normal operation.
- D. Provide portable test resistive load bank for full load test. Provide 4.16kV-480V, 3-phase step-down transformer if a 480V 3-phase load bank is to be used. Simulate power failure including operation of source-transfer switchgear, automatic starting cycle, and automatic shutdown, and return to normal.
- E. The Contractor shall fill the fuel oil day tank to 100% capacity and shall measure and record the fuel level in both above ground fuel oil storage tanks in the presence of the Owner's Representative prior to the start of the test.
- F. The Designer and the Owner shall be notified two (2) weeks in advance of the time and date of this test.
- G. The on-site installation test shall be conducted as follows after all work, including controls upgrades, remote radiator replacement, indoor fuel oil day tank replacement, generator room ventilation system upgrade and all electrical system upgrades have been completed and accepted:
1. With the prime mover in a "cold start" condition and the building load at standard operating level, a primary power failure shall be initiated by opening the service entrance main fusible load-interrupter switch supplying the Ameren utility power to the facility.
 2. The test load shall be the load that is served by the Emergency Power Supply System (EPSS).
 3. The time delay on start shall be observed and recorded.

4. The cranking time until the prime mover starts and runs shall be observed and recorded.
5. The time taken to reach operating speed shall be observed and recorded.
6. The voltage and frequency overshoot shall be recorded.
7. The voltage, frequency, and amperes shall be recorded.
8. The prime mover oil pressure and water temperature shall be recorded, where applicable.
9. The battery charge rate shall be recorded at 5-minute intervals for the first 15 minutes and at 15-minute intervals thereafter.
10. When primary power is returned to the buildings, the time delay on retransfer to primary for each switch with a minimum setting of 5 minutes shall be recorded.
11. The time delay on the prime mover cool down period and shutdown shall be recorded.
12. Allow prime mover to cool for 5 minutes.
13. A resistive load shall be applied for a 4-hour, full load test. The facility load shall be permitted to serve as part or all of the load, supplemented by a load bank of sufficient size to provide a load equal to 100 percent of the nameplate **standby** rating of the Emergency Power Supply (EPS), less applicable derating factors for site conditions. **(ADDENDUM 2, 11/7/25)**
 - a. The new medium-voltage generator connection cabinet shall be used as the connection point for resistive load bank.
 - b. Contractor shall provide a 4.16kV to 480V step down transformer if a 480-volt load bank is utilized.
 - c. The full load test shall be initiated immediately after the cooling time has expired by any method that starts the prime mover and, immediately upon reaching rated rpm, picks up 100 percent of the nameplate kW rating on one step, less applicable derating factors for site conditions.
14. During test, record the following at 5-minute intervals for the first 15 minutes and every 15 minutes for the rest of the test:
 - a. Kilowatts
 - b. Amperes
 - c. Voltage
 - d. Frequency
 - e. Coolant temperature
 - f. Remote radiator cooling water flow
 - g. Room temperature (interior)
 - h. Oil pressure
 - i. Engine exhaust temperature
 - j. Engine inlet temperature
 - k. Oil Temperature
 - l. Battery charge rate

15. Upon completion of the test and after a cool down period, the crank/rest cycle shall be tested.
 - a. Any method recommended by the manufacturer for the cycle crank test shall be utilized to prevent the prime mover from running.
 - b. The control switch shall be set at “run” to cause the prime mover to crank.
 - c. The complete crank/rest cycle shall be observed and recorded.
 16. Test alarm and shutdown circuits as typically performed by the generator supplier.
 - ~~17. The load test with building load, or other loads that simulate the intended load, shall be continued for 2 hours, observing and recording load changes and the resultant effect on voltage and frequency. (ADDENDUM 2, 11/7/25)~~
 18. Correct of all malfunctions such as the elimination of all oil and water leaks, miss-wiring and improper control functions found during testing.
- H. The Contractor/Fabick Power Systems shall provide all necessary metering and measurement equipment required for all testing.
- I. After the test run is concluded and systems have been demonstrated to be satisfactory and ready for permanent operation, all lubrication checked and replenished, if required. Temporary piping, ducting, wiring, instrument connections, etc., shall be removed, and openings restored in a permanent manner acceptable to the Owner's Representative.
- J. Upon completion of the test, the Contractor shall fill the fuel oil day tank to 100% capacity and shall add the required amount of fuel to both above ground fuel oil storage tanks to return the fuel level in each tank to its level prior to the start of testing.
- K. Submit test report(s) with test results and indicating time and date of testing and names of individuals present during testing to the Owner for record.

3.4 ADJUSTING

- A. Adjust generator output voltage and engine speed.

3.5 CLEANING

- A. Clean work under provisions of Division 00, **01** and Section 260500 – Common Work Results for Electrical. **(ADDENDUM 2, 11/7/25)**
- B. Clean engine and generator surfaces.

3.6 DEMONSTRATION

- A. Provide systems demonstration. Coordinate the demonstration schedule with the Owner's Representative and the Designer.
- B. Simulate power outage by interrupting normal source and demonstrate that system operates to provide emergency standby power.

3.7 TRAINING

- A. Provide on-site Owner training by a factory trained field service technician to instruct the Owner's personnel in the proper operation and routine maintenance of the generator control

equipment. Review operation and maintenance manuals, parts manuals and emergency service procedures. This shall be done in accordance with the requirements of Section 017900 – Demonstration and Training after completion of the acceptance testing.

- B. The training sessions shall be video recorded by the Contractor/Fabick Power Systems in accordance with Section 017900 – Demonstration and Training, and the video file uploaded to the Missouri OA FMDC project management website, Trimble (fka eBuilder).

3.8 AIR PERMIT DETERMINATION

- A. The Moberly Correctional Center (MCC) does not presently have an air permit determination for the existing CAT 3516 diesel-engine-driven generator located at the MCC Power House that includes all other combustion engine driven generators at the MCC.
- B. Engage an environmental engineering company to provide an air permit determination for the existing CAT 3516 diesel-engine-driven generator after the new controls modifications specified herein have been completed.
- C. Obtain all required information from project documents, Owner information and a site visit to observe the as-installed condition.
- D. Provide a draft copy of the determination letter for review and a final, “For Record”, air permit determination.
- E. Approved Environmental Engineering Companies:
 - 1. Geotechnology, LLC
 - 2. SCI Engineering
 - 3. UES Professional Solutions, LLC

3.9 FUEL SPILL PREVENTION, CONTROL AND COUNTERMEASURES (SPCC) PLAN

- A. The Moberly Correctional Facility (MCC) does not presently have a fuel spill prevention, control and countermeasures (SPCC) plan for the MCC facility.
- B. Engage an environmental engineering company to provide a SPCC Plan for this facility that includes the new fuel oil day tank specified in Section 231330 – Fuel Oil Day Tank – Diesel Engine Driven Generator as well as all existing fuel storage tanks at the Moberly Correctional Center.
- C. Obtain all required information from project documents, Owner information and site visit to observe the as-installed condition.
- D. Provide a draft copy of the SPCC plan for review and a final, For Record, SPCC document to be signed by an authorized person at the MCC and kept on file at the MCC.
- E. The environmental engineering company engaged to provide the SPCC Plan shall be the same company that is engaged to provide the air permit determination under Article 3.8 above.

END OF SECTION 263213.16

Upgrade Generator Controls & Transfer Switch, Power Plant
Moberly Correctional Center, Moberly, Missouri

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SECTION 263290 – MEDIUM-VOLTAGE GENERATOR CONNECTION CABINET

(ADDENDUM 2, 11/7/25)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SCOPE

- A. The Contractor shall furnish and install a Generator Connection Cabinet as specified herein and as shown on the Drawings.

1.3 RELATED SECTIONS

- A. Section 260500 – Common Work Results for Electrical
- B. Section 260519 – Low-Voltage Electrical Power Conductors & Cables
- C. Section 260526 – Grounding and Bonding for Electrical Systems
- D. Section 260529 – Hangers and Support for Electrical Systems
- E. Section 260533.13 – Conduit for Electrical Systems
- F. Section 260553 – Identification for Electrical Systems
- G. Section 260573 – Protective Device Coordination Study and Arc Flash Risk Assessment
- H. Section 261316 – Medium-Voltage Fusible Load-Interrupter Switchgear (Alternate Bid No. 1)
- I. Section 263623 – Medium-Voltage Automatic Transfer Switch

1.4 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. Underwriters Laboratories, Inc (UL):
 - a. UL 50, Enclosures for Electrical Equipment, Non-Environmental Considerations
 - b. UL 50e, Enclosures for Electrical Equipment, Environmental Considerations
 - 2. National Fire Protection Association (NFPA):
 - a. National Electrical Code (NFPA 70), Article 495, Equipment Over 1000 Volts AC, 1500 Volts DC, Nominal
 - 3. National Electrical Manufacturers Association (NEMA)
 - a. NEMA LA 1 – Surge Arresters

1.5 QUALIFICATIONS

- A. For the equipment specified herein, the Generator Connection Cabinet shall be of standard design and manufacture, and not a custom-built piece of equipment.
- B. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Designer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

1.6 REGULATORY REQUIREMENTS

- A. The Generator Connection Cabinet shall be UL listed and labeled as a complete assembly.

1.7 SUBMITTALS

- A. Shop Drawings:
 - 1. Overall product dimensions: height, width, depth
 - 2. Front and side elevation views
 - 3. Foot/wall print
 - 4. Line & load connection details
 - 5. Conduit entry location(s)
 - 6. Assembly ratings including
 - a. Short-circuit rating
 - b. Voltage
 - c. Continuous current amperage rating
- B. Product Technical Data:
 - 1. 600A dead-break bushings
 - 2. Elbow type surge arresters
 - 3. 600A dead-break bushing to 200A load-break elbow adapters
 - 4. Phase rotation monitor

1.8 DELIVERY, STORAGE, AND HANDLING

- A. See Specification Section 260500 - Common Work Results for Electrical

1.9 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of Generator Connection Cabinet that fail in materials or workmanship within specified warranty period .
 - 1. Warranty Period: One (1) year from date of substantial completion of the project

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

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MEDIUM-VOLTAGE GENERATOR CONNECTION CABINET

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- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. APT Power Solutions
 2. Eaton
 3. ESL Power Systems
 4. Power Temp Systems
 5. Trystar

2.2 GENERATOR CONNECTION CABINET

- A. Ratings:
1. Voltage and amperage: 4.16Y/2.4kV, 3-phase, 3-wire, 600A
 2. Short circuit current rating:
 - a. Momentary (10-Cycle) Current: 40 kA RMS Asymmetrical
 - b. 2-Second Current: 25 kA RMS Symmetrical
 3. Do not order generator connection cabinet until the required short-circuit current ratings have been determined in accordance with Specification Section 260573 – Protective Device Coordination Study and Arc Flash Risk Assessment.
- B. Construction:
1. Bus material: 1000A/in² silver-plated copper
 2. All bus shall be supported utilizing a high strength and high creep support providing a minimum of 10.5-inch creep distance between phases and ground. The molded fins shall be constructed of high track resistant polyester or cycloaliphatic epoxy.
 3. All standoff insulators on switches and fuse mountings shall be of high track resistant fired polyester or cycloaliphatic epoxy.
 4. Permanent bus connection:
 - a. Arranged for bottom feed.
 - b. Two-hole rectangular tongue, long-barrel compression lugs
 - c. Quantity: As required for the number of conductors indicated on the Drawings
 5. Field (temporary) wiring connections:
 - a. Temporary Generator Connection: 5 kV, 600 Amp, 60 kV BIL rated dead-break bushings, conforming to ANSI/IEEE Standard 386 and ANSI Standard C119.2, with semiconductive coating solidly grounded.
 - b. Quantity: 2 per phase with protective covers in place for shipping and storage
 - c. Dead-break parking stands: 1 per phase
 6. 200A minimum rated silver-plated copper ground bus.
- C. Enclosure:

1. Outdoor pad-mount
2. NEMA 3R rated
3. Material: Carbon steel, aluminum or stainless steel
4. Finish: Bare metal (aluminum or stainless steel only) or ANSI 49 or ANSI 61 powder coat finish
5. Pad-lockable outdoor door for dead-break elbow compartment
6. Pad-lockable latches on medium voltage cable access door
7. Drip hood

D. Optional Features

1. Keyed mechanical interlock on dead-break elbow access compartment to prevent opening the dead-break compartment door on the generator connection cabinet unless the emergency circuit breaker in the medium-voltage closed-transition automatic transfer switch has been opened first to release the interlock key. The keyed interlock will be provided by the supplier of the Section 263623 – Medium-Voltage Automatic Transfer Switch to the supplier of the medium-voltage generator connection cabinet, specified under this Section, for installation on the dead-break compartment door at the factory.
2. Three (3) elbow type surge arresters rated 6 kV, 5.10 kV MCOV
3. Three (3) 2,400V to 120V potential transformers with primary and secondary fusing for phase rotation monitor.
4. Phase rotation monitor
 - a. Three (3) 120V (1 per phase), 60 Hz
 - b. Analog monitoring relay
 - c. Repeatability accuracy: 1%
 - d. LED indicators for phase failure and phase sequence
 - e. Self-resetting
 - f. Response time: 450 ms maximum
 - g. Impulse resistance: 6 kV
 - h. Operating temperature: -25°C to 60°C
 - i. Screw-type terminals for up to two (2) 20AWG to 14AWG solid or stranded conductors per terminal.
 - j. Output relay: 3A @ 250VAC, 1A @ 24VDC, 0.2A @ 125VDC, 0.1A @ 250VDC
5. 20-amp rated terminal strip for temporary generator auto-start signal from medium-voltage automatic transfer switch and control wiring connections
6. NEMA Type 4/4X/13 (watertight/corrosion resistant/oiltight), 30- or 30.5-mm round plastic, two-position, maintained contact, panel mounted with the Standard Operator labeled “TEMP GENERATOR” and “PERMANENT GENERATOR” with separate N.O dry contacts for switching between the following:
 - a. Permanent generator and temporary generator 24VDC power to the ATS remote start monitoring system receiver in the generator control panel.

- b. Automatic transfer switch generator automatic start signal to permanent generator or temporary generator.
 - c. Any other signal that must be sent either the permanent generator or the temporary generator but not both simultaneously.
- 7. QTY (1) 125V, single-phase, 20-amp rated, 2-pole, 3-wire grounding, straight blade, marine grade, yellow nylon face, corrosion resistant, nickel-plated brass power contacts and mounting strap, brass ground contact, stainless steel mounting screws, single receptacle, NEMA 5-20R configuration meeting Federal Specification W-C-596, NEMA WD-6, UL 498 listed and labeled; Hubbell HBL53CM61 or approved equal by Arrow-Hart or Leviton with aluminum, spring loaded weatherproof cover for temporary generator battery charger connection
- 8. QTY (2) 125V, single-phase, 30-amp rated, 2-pole, 3-wire grounding, twist-lock, marine grade, yellow nylon face, corrosion resistant, nickel-plated brass contacts and mounting strap, stainless steel mounting screws, single receptacle, NEMA L5-30R configuration meeting Federal Specification W-C-596, NEMA WD-6, UL 498 listed and labeled; Hubbell HBL26CM10 or approved equal by Arrow-Hart or Leviton with aluminum, spring loaded weatherproof cover for temporary generator jacket water heater connections.
- 9. All low-voltage items must be provided in a dedicated low-voltage compartment with metal barriers to isolate this compartment from the medium-voltage portion of the generator connection cabinet.
- 10. Permanent labeling with engraved laminated plastic nameplates per Specification 260553 – Identification for Electrical Systems.

E. Standards: UL 1008 Supplement SB: Standard for Accessories, Transfer Switch

2.3 SURGE ARRESTERS

- A. Provide three (3) 6 kV duty cycle voltage rated, 5.10 kV MCOV, load-break elbow, plug in, MOV type surge arresters, with braided copper ground conductor, 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. Provide three (3) 600A dead-break bushing to 200A load-break elbow adapters to allow installation of load-break elbow arresters on the 600A dead-break bushings in the medium-voltage generator connection cabinet.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install as indicated and in accordance with manufacturer's recommendations and instructions.
- B. Connect as indicated in one-line diagram.

3.2 INSTRUCTIONS

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- A. Provide instructions indicating the procedure for connecting a temporary generator to the facility to allow taking the permanent generator out of service for maintenance, repairs or replacement shall be applied to the front of the inner panel behind the outer door or to the inside of the outer door. Instructions shall be weather resistant and permanently applied.

3.3 ARC FLASH HAZARD WARNING LABEL

- A. Provide arc flash hazard warning label on exterior door of generator connection cabinet in accordance with Sections 260553 – Identification for Electrical Systems and 260573 – Protective Device Coordination Study and Arc Flash Risk Assessment.

END OF SECTION 263290

SECTION 263623 – MEDIUM-VOLTAGE AUTOMATIC TRANSFER SWITCHES

(ADDENDUM 2, 11/7/25)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SCOPE

- A. The Contractor shall furnish and install a medium-voltage automatic transfer switch (MVATS) as specified herein and as shown on the Drawings.
- B. The MVATS shall consist of a 5 kV medium-voltage freestanding metal-clad switchgear with vacuum circuit breakers and a microprocessor controller to provide automatic operation.
- C. The MVATS, generically referred to as ATS throughout this document, shall be used to automatically transfer the Moberly Correctional Center facility load from the normal Ameren Missouri power source to the existing diesel-engine-driven emergency generator at the Power Plant upon a failure of the normal power source.
- D. The ATS shall transfer its connected load without interruption (closed transition) by momentarily connecting both sources of power only when both sources are present and acceptable. The maximum interconnection time shall be 100 milliseconds. The ATS shall operate as a conventional break-before-make (open transition) switch when the power source serving the load fails.
- E. The medium-voltage closed-transition automatic transfer switch shall be fully compliant with Ameren Missouri requirements in “Document C0 – Generator Connection Request Form” that is included as Attachment 1 at the end of this specification section.

1.3 RELATED SECTIONS

- A. Division 3 – Concrete
- B. Section 230900 – Instrumentation and Control for HVAC
- C. Section 260500 – Common Work Results for Electrical
- D. Section 260526 – Grounding and Bonding for Electrical Systems
- E. Section 260529 – Hangers and Supports for Electrical Systems
- F. Section 260533.13 – Conduit for Electrical Systems
- G. Section 260553 – Identification for Electrical Systems
- H. Section 260573 – Protective Device Coordination Study and Arc Flash Risk Analysis
- I. Section 260583 – Wiring Connections

- J. Section 261350 – Neutral Grounding Resistor
- K. Section 263213.16 – Diesel-Engine-Driven Generator Set Controls

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's product data for the automatic transfer switch including, but not limited to, service voltages, number of phases, frequency, continuous current ratings, interrupting current ratings and enclosure type. Product data sheets shall indicate all standard features, special features and optional features that are to be provided. As a minimum, provide product data for all of the following items:
 - 1. Microprocessor based ATS controller including programming options
 - 2. Vacuum circuit breakers
 - 3. Circuit breaker control switches
 - 4. Protective relays
 - 5. Protective relay in-service test switch unit
 - 6. Lockout relays
 - 7. Capacitive trip units
 - 8. Potential (voltage) transformers, including outline drawing
 - 9. Current transformers, including outline drawing and curves
 - 10. Electronic power and energy meter
 - 11. Extended parallel timing relay
 - 12. Surge arresters
 - 13. Engine-generator start circuit integrity monitoring transmitter and receiver devices
 - 14. Pilot lights, push buttons and selector switches
- B. Shop Drawings: Submit dimensioned plan view and front, rear and side elevation outline drawings and internal physical diagrams for the ATS.
- C. Wiring Diagrams: Submit wiring diagrams for the ATS showing internal and external connections for power, control and communications wiring and circuit breaker and protective relaying control schematics.
- D. Bill of Materials: Provide a complete Bill of Materials of all items, listing items by quantity, description and manufacturer's catalog number that includes relay style numbers and/or ranges, current transformer ratio, surge arrester catalog numbers, etc.
- E. ATS manufacturer's equipment nameplate drawing
- F. Seismic Certification: Provide seismic free-standing qualification certificate for the complete ATS assembly.
- G. The manufacturer shall provide a notarized letter certifying compliance with all of the requirements of this specification including compliance with the specified codes and standards and withstand and closing ratings. The certification shall identify, by serial number(s), the equipment involved. No exceptions to the specifications, other than those stipulated at the time of the submittal, will be permitted to be included in the certification.

- H. The ATS submittals will not be approved until the required short-circuit current ratings and power circuit breaker protective relay settings have been determined in accordance with Specification Section 260573 – Protective Device Coordination Study and Arc Flash Risk Assessment.
- I. The ATS submittals will be submitted to the local utility company, Ameren Missouri, for their approval before a release for manufacturing will be granted. Allow 30 calendar days in the construction schedule for the Ameren submittal review.
- J. Submit Installation, Operation and Maintenance (IO&M) Manuals in accordance with Sections 007213 – General Conditions, 017823 – Operation and Maintenance Data and 260500 – Common Work Results for Electrical.
- K. ATS startup and commissioning test reports indicating settings of all adjustable items, including time delay settings and power circuit breaker protective relay settings.
- L. O&M Manuals shall be conformed to “as-built” status by incorporating any and all changes made during the startup period.

1.5 REFERENCES

- A. The medium-voltage closed-transition automatic transfer switch shall be designed and manufactured according to the applicable provisions of the latest revision of the following codes and standards:
 - 1. ANSI/IEEE C37.04 – IEEE Standard for Ratings and Requirements for AC High-Voltage Circuit Breakers with Rated Maximum Voltage Above 1000 V
 - 2. ANSI/IEEE C37.06 – IEEE Standard for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis–Preferred Ratings and Related Required Capabilities for Voltages Above 1000 V
 - 3. ANSI/IEEE C37.09 – IEEE Standard Test Procedures for AC High-Voltage Circuit Breakers with Rated Maximum Voltage Above 1000 V
 - 4. ANSI/IEEE C37.11 – IEEE Standard Requirements for Electrical Control for AC High-Voltage (> 1000 V) Circuit Breakers
 - 5. ANSI/IEEE C37.20.2 – IEEE Standard for Metal-Clad Switchgear
 - 6. ANSI/IEEE C37.90.1 – IEEE Standard for Relays, Relay Systems, and Control Devices used for Protection and Control of Electric Power Apparatus–Surge Withstand Capability (SWC) and Electrical Fast Transient (EFT) Requirements and Tests
 - 7. ANSI/IEEE C37.100.1 – IEEE Standard of Common Requirements for High Voltage Power Switchgear Rated Above 1000 V
 - 8. ANSI/IEEE C27.112 – IEEE Standard for Inverse-Time Characteristics Equations for Overcurrent Relays
 - 9. ANSI/IEEE C57.13 – IEEE Standard Requirements for Instrument Transformers
 - 10. ANSI/IEEE Standard 446 – IEEE Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications (Orange Book)
 - 11. IEEE 241 – IEEE Recommended Practice for Electric Power Systems in Commercial Buildings (Gray Book)

12. NFPA 70 – National Electrical Code, including use in emergency and standby systems in accordance with Articles 700, 701 and 702, as applicable
13. NFPA 101 – Life Safety Code
14. NFPA 110 – Standard for Emergency and Standby Power Systems
15. UL 50 – Enclosures for Electrical Equipment
16. UL 508 – Industrial Control Equipment
17. UL 1008A – Standard for Transfer Switch Equipment, Over 1000 Volts

1.6 QUALIFICATIONS

- A. The manufacturer of the ATS assemblies shall have produced similar electrical equipment for a minimum of fifteen (15) years. When requested by the Designer, an acceptable list of a minimum of ten (10) installations with similar equipment shall be provided to demonstrate compliance with this requirement.
- B. The ATS manufacturer shall maintain a full parts and service center with 24/7/365 service availability within one hundred (175) miles of the project site and all service personnel shall be factory trained and certified.
- C. The ATS manufacturer shall maintain records for the ATS, by serial number, for a minimum of twenty (20) years.
- D. The ATS and control module/controller shall be the product of the same manufacturer.
- E. As a precondition for approval, all automatic transfer switches, complete with accessories, shall be listed by Underwriters Laboratories, under UL Standard 1008A and approved for use on emergency systems. The ATS assembly shall be labeled by a Nationally Recognized Testing Laboratory (NRTL).
- F. Provide equipment that is IBC/CBC seismically qualified with seismic freestanding label.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Inspect equipment and report concealed damage to carrier within their required time period.
- B. Handle equipment carefully and in accordance with manufacturer's recommendations to avoid damage to internal components, enclosure, and finish.
- C. Store equipment in a clean, dry indoor environment. Maintain factory packaging until time of installation. Cover with heavy canvas or plastic to keep out dirt, water and construction debris. Heat enclosures to prevent condensation.

1.8 WARRANTY

- A. Manufacturer shall warrant equipment to be free from defects in materials and workmanship for a minimum period of one (1) year from date of substantial completion of the project.

PART 2 - PRODUCTS

2.1 GENERAL

- A. The medium-voltage automatic transfer switch shall automatically transfer the assigned load (L) from the “Normal” (N) source to the “Emergency” I source upon a loss of normal source power (open transition), and retransfer back again upon restoration of normal source power (closed transition).
- B. The complete ATS assembly shall be UL Listed and Labeled in accordance with UL 1008A.
- C. The ATS shall be supplied with a microprocessor-based control panel as specified herein.
- D. The medium-voltage closed transition ATS shall transfer the load in a parallel mode, thus momentarily connecting both sources of power. A closed transition transfer shall occur only when both sources are available and within specified limits. The maximum interconnect time is 100 milliseconds. The transfer switch shall operate in an “open transition” mode (break-before-make) when the power source serving the load fails.
- E. Design Loads:
 - 1. The ATS assembly, as well as the means of fastening to the building and/or the concrete equipment pad/floor below the concrete equipment pad, shall be capable of withstanding gravity, operating, and seismic loads.
 - 2. The latest editions of the International Building Code and ASCE 7 – Minimum Design Loads for Buildings and Other Structures shall be used as the design code with the specific environmental factors as stated below.
 - 3. Comply with the ASCE Hazards Report for site included as Attachment 1 to Section 260500 – Common Work Results for Electrical.
 - 4. Earthquake Design Data:
 - a. Occupancy Classification:
 - 1) Power Plant: Moderate-hazard factory industrial, Group F-1
 - 2) Correctional Center: Institutional Group I-3, Condition 5
 - b. Risk Category: IV
 - c. Seismic Importance Factor: $I_e = 1.5$
 - d. Site Class: D
 - e. Mapped Spectral Response Accelerations: $S_s = 0.23$, $S_1 = 0.1$
 - f. Spectral Response Coefficients: $SDS = 0.2$, $SD1 = 0.14$
 - g. Seismic Design Category: D
 - h. Component Amplification Factor: $A_p = 2.5$
 - i. Component Response Modification Factor: $R_p = 2$
 - j. Overstrength Factor: $\Omega_o = 2$
 - k. Analysis Procedure: Equivalent Lateral Force ASCE 7

2.2 METAL-CLAD ATS SWITCHGEAR ASSEMBLY

- A. The metal-clad switchgear shall consist of a Type 1 indoor enclosure containing two (2) vacuum circuit breakers and the necessary accessory components, all factory assembled (except for necessary shipping splits) and operationally checked. The assembly shall be self-supporting and floor mounted on a level concrete pad. The integrated switchgear assembly shall withstand the effects of closing, carrying and interrupting currents up to the assigned maximum short circuit rating.
- B. Due to limited space in the generator room, the maximum allowable depth and width of the ATS assembly shall be: 6'-0" wide by 7'-7" deep.
- C. Equipment Ratings:
 - 1. System Voltage: 4.16 kV nominal, 3-phase, 4-wire low resistance grounded, 60 Hz
 - 2. Maximum Design Voltage: 4.75 kV
 - 3. Basic Impulse Level (BIL): 60 kV
 - 4. Power Frequency Withstand (1 minute test): 19 kV
 - 5. Main Bus Ampacity: 1200 A continuous
 - 6. Momentary Current Ratings (equal to circuit breaker close and latch rating): 25 kA at 5 kV.
- D. Do not order the automatic transfer switch 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.
- E. The entire ATS assembly, including power circuit breakers, protective relays, instrument transformers, power/energy meter, etc., shall be completely factory-built, assembled, wired and tested. All equipment and components shall be of new construction.
- F. All incoming and outgoing cables and conductors shall enter/exit the top of the switchgear enclosure. There is no bottom access to the enclosure.

2.3 STATIONARY STRUCTURE

- A. The switchgear shall include two metal-clad structural sections, one circuit breaker section and one auxiliary section with potential transformer assemblies for the Normal and Emergency sources assembled to form a rigid self-supporting completely enclosed structures providing steel barriers between sections.
- B. The first section shall be divided by metal barriers into the following compartments:
 - 1. Emergency source circuit breaker with protective relay and lockout relay
 - 2. Normal source circuit breaker with protective relay and lockout relay
 - 3. Main bus
 - 4. Cable
- C. The second section shall be divided by metal barriers into the following compartments:
 - 1. Emergency source potential transformers

2. Normal source potential transformers
 3. Load bus
 4. Cable
- D. Each power circuit breaker compartment shall be wired complete, including the circuit breaker, current transformers, electrical protection relay, surge arresters and all associated equipment.
 - E. The auxiliary compartment shall be wired complete with emergency and normal source potential transformers, power/energy meter, ATS microprocessor-based controller and all associated equipment.

2.4 MAIN BUS CONDUCTORS AND COMPARTMENTS

- A. The main bus is to be 1200 amps continuous rated, silver-plated copper.
- B. All bus conductors shall be fully insulated throughout the entire length, with flame retardant, track resistant insulation. Bus insulation shall encase the bus conductors with a high dielectric, thermosetting epoxy insulation using the fluidized-bed process. Insulating barriers shall be provided where primary buses pass from one compartment to another.
- C. Bolted bus connections, where required, shall be silver-plated copper with a minimum of two (2) bolts per joint, with split locking washers or cupped Belville washers, and insulated with red insulating boots secured with plastic pins or zip ties. Bus joints shall not be welded.
- D. Bus supports shall be flame retardant track resistant glass polyester or cycloaliphatic epoxy. Bus bars shall be braced to withstand fault currents equal to the close and latch rating of the breakers. The temperature rise of the bus and connections shall be in accordance with ANSI standards and documented by design tests.
- E. The switchgear buses shall be arranged so that phases A, B, C are from top to bottom, front to back, and left to right when viewing from the front of the switchgear.
- F. The main power disconnecting contacts shall be extended into the bus compartment by means of glass polyester or finned cycloaliphatic epoxy bushings. These bushings shall also have provisions for mounting current transformers. All bushings shall be flame retardant and track resistant. Flexible bus bar connectors shall be used wherever considered necessary by the switchgear manufacturer.
- G. The main bus enclosure shall be separated from the other enclosures by an 11-gauge steel barrier or equivalent and shall fully enclose the main bus. Access to this compartment shall be provided from the front or rear of the structure by removing a steel barrier. All bus work and connections shall be accessible for inspection and maintenance after first removing the necessary cover plates/barriers.
- H. The rear of each switchgear vertical section shall have a full height hinged door with vault-type, pad-lockable handle.
- I. Current transformers, surge arrestors, and any other stationary auxiliary equipment shall be mounted in the cable compartments as shown on the single line diagram and product data sheets.

- J. *Ground Bus*: A ¼-inch by 2-inch silver-plated copper ground bus shall extend through the entire length of the transfer switch assembly. Each breaker grounding contact, each cable compartment ground terminal, all surge arrester ground connections and all metal parts of the structure shall be effectively connected to this ground bus. Station ground connection points shall be located in each end section.

2.5 CIRCUIT BREAKER COMPARTMENTS

- A. Each circuit breaker compartment shall be designed to house a horizontal draw-out vacuum circuit breaker.
- B. Circuit breakers of same type, rating and control circuit configuration shall be electrically and mechanically interchangeable without having to change any wiring.
- C. Blocking devices shall interlock breaker frame sizes to prevent installation of a lower ampere rating or interrupting capacity element into a compartment designed for one of a higher rating.
- D. The stationary primary disconnecting contacts shall be silver-plated copper, recessed within insulating tubes, and shall be field replaceable. Entrance to the stationary primary disconnecting contacts shall be automatically covered by metal shutters when the circuit breaker is withdrawn from the connected position to the test or disconnected position or removed from the circuit breaker compartment. Provide rails to allow withdrawal of the power circuit breaker for inspection and maintenance without the use of a separate lifting device.
- E. The movable contacts and springs shall be mounted on the circuit breaker element for ease of inspection/maintenance. The secondary contacts shall be silver-plated and shall automatically engage in the breaker OPERATING position.
- F. Entrance to the stationary primary DISCONNECTING contacts shall be automatically covered by bright orange or gray grounded shutters when the circuit breaker is withdrawn to the TEST or DISCONNECTED position or removed from the circuit breaker compartment.
- G. A ground bus shall be extended into the circuit breaker compartment to automatically ground the breaker frame with high-current spring type grounding contacts located on the breaker chassis when the breaker is in the TEST and CONNECTED positions. Guide rails for positioning the circuit breaker and all other necessary hardware are to be an integral part of the circuit breaker compartment.
- H. Each power circuit breaker compartment door shall have a hinged door with pad-lockable handle.
- I. Mounted in the outer door of each circuit breaker compartment shall be a circuit breaker control switch and red for “CLOSED”, green for “OPEN” and amber for “TRIPPED” indicating status pilot lights for control and status indication of the circuit breaker contained within the compartment.

2.6 POWER CIRCUIT BREAKERS

- A. The power circuit breakers shall be three-pole, single-throw, horizontal draw-out, removable, rated 4,160 nominal volts, 4,760 maximum volts, 60 Hz, with a continuous

current rating of 1200 amps and a maximum symmetrical interrupting rating of 40 kA/250 MVA with 3 cycle total interrupting time.

- B. Furnish vacuum circuit breakers with one vacuum interrupter per phase and with proper surge suppression to protect against transient recovery voltage due to switching.
- C. Circuit breakers shall be operated by an electrically charged, mechanically and electrically trip-free, stored-energy operating mechanism. Provisions shall be included for manual charging of the mechanism and for slow closing of the contacts for inspection or adjustment.
- D. Circuit breakers shall be equipped with self-aligning silver-plated copper primary and secondary disconnecting devices, grounding contacts, position indicator, and an auxiliary switch consisting of 2 normally open and 2 normally closed "spare" auxiliary contacts in addition to those required by the manufacturer.
- E. Secondary control circuits shall be connected automatically with a self-aligning, self-engaging plug and receptacle arrangement when the circuit breaker is racked into the CONNECTED position. Provision shall be made for secondary control plug to be manually connected in the TEST position.
- F. The racking mechanism to move the breaker between positions shall be operable with the front door closed and position indication shall be visible with door closed.
- G. Circuit breaker shall be provided with self-aligning contacts for grounding the removable elements when they are inserted in the housings or in the TEST position. Circuit breaker removable elements shall have three (3) distinct positions in their housings: "Inserted" ready for operation; "Test", primary contacts separated a safe distance and secondary contacts connected; and "Removed", primary and secondary contacts separated a safe distance.
- H. Design of the circuit breakers shall be such that they will provide successful interruption of low magnetizing currents, as well as high load currents and short-circuit currents.
- I. The breaker compartment shall be furnished with a mechanism which will move the breaker between the operating and disconnect positions. The mechanism shall be designed so that the breaker will be self-aligning and will be held rigidly in the operating position without the necessity of locking bars or bolts. In the disconnect position, the breaker shall be easily removable from the compartment. Dead front protection shall be maintained throughout the withdrawal operation.
- J. Interlocks shall prevent moving the breaker to or from the operating position unless its contacts are in the open position. As a further safety precaution, the operating springs shall be discharged automatically when the breaker is rolled fully into the compartment or is moved into the disconnect position. Means shall be provided for padlocking the racking mechanism in either the connected (operating) position or the disconnected position. When locked in the disconnected position, the breaker shall be removable from the compartment. Padlocking shall not interfere with operation of the breaker or its mechanism.
- K. The circuit breaker control voltage shall be 120 volts AC close with capacitor trip.
- L. Circuit breakers shall be operated by means of a stored energy mechanism which is normally charged by a universal motor but can also be charged by a manual handle for

manual emergency closing or testing. The closing speed of the moving contacts shall be independent of both the control voltage and the operator.

- M. Circuit breakers shall have two physical positions in the circuit breaker compartment; namely, CONNECTED and TEST/DISCONNECT. There shall be three functional positions; namely, CONNECTED, TEST, and DISCONNECT.
 - 1. In the CONNECTED position the circuit breaker is racked into the compartment until both the primary high voltage contacts and the secondary control power contacts are made. The circuit breaker is fully operational in this position and it is locked securely in place by the racking mechanism.
 - 2. In the TEST position the secondary control power contacts are made and the circuit breaker can be opened and closed electrically. The shutters are closed and cover the primary high voltage contacts isolating the separable high voltage contacts of the circuit breaker from the main bus and the terminals. The circuit breaker is prevented from accidentally moving into the compartment by the racking arms and from moving out toward the door by the DISCONNECT position latch.
 - 3. In the DISCONNECT position both the circuit breaker secondary control power contacts and the separable high voltage contacts are disconnected and the circuit breaker is not operable electrically. The circuit breaker is held in position the same as in the TEST position.
 - 4. All of the above positions (including breaker removal) shall permit closing of the compartment door.
- N. An interlock known as "Cell Interlock" shall be provided in each breaker compartment for locking a breaker out of the CONNECTED position.
- O. The cell interlock shall operate by locking the shutters closed, thereby preventing the racking of the breaker into the CONNECTED position. The cell interlock shall have provisions for padlocking. The breakers shall be stored in the TEST/DISCONNECT position with the cell interlock locked.
- P. A full front shield shall be provided on the breaker element designed to barrier operating personnel from live primary bus when the breaker is installed in the circuit breaker compartment. Positive contact secondary disconnect shall be through automatic self-aligning, self-engaging type plug contact arrangement. Provision shall be made for control power plug to be disconnected in TEST position.
- Q. Three (3) Breaker Element Mounted Auxiliary Switch Contacts (one 52a, two 52b) shall be provided for external use.
- R. In addition to the breaker mounted auxiliary switch contacts, the breakers shall be equipped with a Mechanism Operated Cell (MOC) Switch having 5 normally open (52a) and 5 normally closed (52b) sets of independent and isolated contacts. The MOC contacts shall be compartment mounted auxiliary switch contacts mechanically operated by the circuit breaker mechanism in both the CONNECTED and TEST/DISCONNECTED positions and shall indicate the OPEN or CLOSED position of the circuit breaker the same as Breaker Mounted Auxiliary Switch Contacts. The MOC contacts shall be in the "normal" state when the breaker is OPEN, and shall switch to the opposite state when the breaker is CLOSED.

- S. Breakers shall be equipped with a Truck Operated Cell (TOC) Switch having 5 normally open and 5 normally closed sets of independent and isolated contacts. The Truck Operated Cell switches shall positively identify whether the breaker is in the connected (OPERATE) position or in the TEST/DISCONNECTED position, and shall be mechanically operated by the position of the breaker element in the cell. The “normal” state of the contacts is when the breaker element is in the CONNECTED position. The contacts are switched to the opposite state when the breaker element is either in “he TES” position or removed from the cell (DISCONNECTED).
- T. The above number of auxiliary switch contacts, Mechanism Operated Cell switches, and Truck Operated Cell switches are a minimum. The quantities shall be increased if required by the design of the system.
- U. Each circuit breaker shall be provided with an operations counter.
- V. Each circuit breaker shall have a contact wear indicator and provisions for slow closing to permit measurement of contact wear during breaker maintenance.
- W. Provide circuit breaker overhead lifting mechanism factory mounted to the top of the circuit breaker vertical section allow lifting either of the two (2) power circuit breakers that have been completely withdrawn from the switchgear from the breaker rails to the floor in front of the switchgear for maintenance or testing out of the switchgear. A portable circuit breaker lift truck is not acceptable as a means of removing circuit breakers from the switchgear, as there is no place to store the device on-site.

2.7 CABLE COMPARTMENTS

- A. The bus bars from the line side of both circuit breakers and the common load bus shall be extended into the cable compartments by means of glass polyester or finned cycloaliphatic epoxy bushings. Barriers shall be provided to isolate each set of bus bars from all others.
- B. Circuit breaker line side bus bars and common load side bus bars shall be provided with NEMA hole drilling for up to two (2) two-hole, rectangular tongue, long-barrel, compression connectors per phase with 15 kV Class 1 cable terminators.
- C. Sufficient space shall be provided at each cable termination for the 15 kV Class 1 cable terminators. All cables shall enter/exit the cable compartments at the top of the switchgear enclosure.
- D. Provide adequate cable training space for incoming and outgoing 15 kV shielded power cables.
- E. Each cable compartment shall have a hinged door with vault-type, pad-lockable handle.

2.8 DOORS AND PANELS

- A. Relays, control switches, etc., shall be mounted on a formed front-hinged panel for each circuit breaker compartment. Front doors shall include features to facilitate quick and complete removal or reinstallation of entire front door assembly. Door hinges shall have removable pins. Where allowable, all control circuits (except, for example, current transformers and grounding) shall be wired via plugs/receptacles prior to termination.

2.9 INSTRUMENT TRANSFORMERS

- A. Current Transformers: All current transformers (CTs) shall be high accuracy single or multi ratio as indicated. Current transformers requiring metering accuracy shall be ANSI Class 0.3-BO.5; current transformers requiring relay accuracy shall be as follows:

RATIO <u>XXXX: 5A</u>	RELAYING ACCURACY <u>(ANSI CLASS)</u>
50 thru 75	C20
100 thru 150	C50
200 thru 300	C100
400 thru 1000	C200
1200	C400

- B. Each current transformer assembly shall be insulated for the full voltage rating of the switchgear. Each set of current transformers shall be connected in grounded wye configuration, unless otherwise indicated, and shall be front accessible to permit adding or changing current transformers without removing high voltage insulation connections.
- C. All current transformer leads shall be connected to a separate terminal block having two terminals for each current transformer secondary tap. These terminals shall provide an arrangement for easy extension of the current transformer circuit to accommodate externally located components, as well as providing a means of accommodating jumper wires at the terminal block. Shorting terminal blocks shall be provided, and ring tongue connectors shall be used.
- D. Provide an additional set of three (3) current transformers, in accordance with Fabick Power System's requirements, wired out to shorting type terminal blocks for field connection to the remote mounted generator control panel (GCP), if/as required.
- E. Provide an additional set of three (3) current transformers on the common load bus wired through a shorting type terminal block for the current inputs to the power/energy meter.
- F. Provide an additional set of three (3) current transformers, for the generator differential protection function of the generator protection relay, shipped loose for field installed inside the generator wiring compartment by others.
- G. Potential Transformers: Potential transformer (PT) ratio shall be as indicated on the one-line diagram and all PTs shall have both primary and secondary overcurrent and short circuit protection. Overcurrent and short circuit protection shall be provided by current limiting fuses having an interrupting rating equal to or greater than the maximum short-circuit current available at that point from an infinite bus.
- H. PTs shall have a mechanical rating equal to the momentary interrupting rating of the power circuit breakers.
- I. PTs shall have relaying and metering accuracy per ANSI Standards.
- J. All PTs shall have provisions to disconnect power before removing the primary and/or secondary fuses.
- K. Potential transformers shall be installed in a draw-out or trunnion type mounting that shall de-energize both the primary fuses and the transformer when the drawer is withdrawn.

- L. Rails shall be provided for each drawer to permit easy inspection, testing, and fuse replacement. A shutter assembly or other approved physical barrier shall be provided to prevent contact with live primary parts when a potential power transformer drawer is withdrawn.
- M. Control Power Transformer: Control power transformer (CPT) shall be 2400VAC to 120VAC. CPT shall have both primary and secondary overcurrent and short circuit protection. Overcurrent and short circuit protection shall be provided by current limiting fuses having an interrupting rating equal to or greater than the maximum short-circuit current available at that point from an infinite bus.
- N. CPT shall have a mechanical rating equal to the momentary interrupting rating of the power circuit breakers.
- O. CPT shall have provisions to disconnect power before removing the primary and/or secondary fuses.
- P. CPT shall be installed in a draw-out or trunnion type mounting that shall de-energize both the primary fuses and the transformer when the drawer is withdrawn.
- Q. Rails shall be provided for each drawer to permit easy inspection, testing, and fuse replacement. A shutter assembly or other approved physical barrier shall be provided to prevent contact with live primary parts when a CPT drawer is withdrawn.

2.10 PROTECTIVE RELAYS

- A. Provide two (2) multifunction, multiphase, microprocessor based protective relays. One for the normal (utility) source circuit breaker and one for the emergency (diesel-engine-driven generator) source circuit breaker.
- B. Protective relays units shall be packaged in a steel case suitable for semi-flush or flush mounting in the door of the switchgear circuit breaker compartment. Relays shall be draw-out type (testable in case) to allow for quick removal without the need for removal of hardware.
- C. The microprocessor-based logic unit along with the power supply, PTs and CTs shall be able to be totally withdrawn from the case and interchanged with other cases without the need for recalibration. CT shorting bars shall be an integral part of the unit case.
- D. All connections to each relay shall be via terminals on the rear of the unit.
- E. ANSI trip and reset times shall conform to IEEE C37.112.
- F. Protective relays shall have built-in field selectable time-overcurrent and instantaneous trip curves.
- G. Each protective relay unit shall include a complete power and energy metering package to display critical data on the utility and generator power sources.
- H. Protective relay units shall include fault and event recording capability.
 - 1. Events shall be time and date tagged and stored in non-volatile memory.
 - 2. Faults shall be recorded in non-volatile memory and each record shall include a record number, time and date and single-phase current values.

- I. The protective relays shall include a human-machine interface (HMI) with 2 line by 20 character (minimum) backlit liquid crystal display (LCD). Critical operation indicators shall also be provided.
- J. The HMI shall be used for local viewing and changing of settings, record retrieval and metering. Keys shall be provided on the front face of the relay unit with an easy to follow menu system that allows for quick and easy navigation. The HMI LCD shall continuously display the primary system currents in all three phases.
- K. The protective relay units shall have an RS-485 port for communications.
- L. Protective relays shall include programmable outputs for “trips” and “relay failure alarm” as a minimum.
- M. Protective relays shall operate from a control source input of 120VAC, single-phase, 60Hz.
- N. Relay protective functions implemented on the two protective relays shall be determined by the Missouri Professional Engineer retained to complete the work specified under Section 260573 – Protective Device Coordination Study and Arc Flash Risk Assessment as required for compliance with Ameren Missouri and Caterpillar requirements/recommendations.
- O. The protective relays shall be:
 - 1. Utility source protective relay: GE Multilin Model 850, Schweitzer Engineering Laboratories SEL-751 or approved equal by Basler Electric (may require more than one relay to provide all required relay functions)
 - 2. Generator source protective relay: GE Multilin Model 889, Schweitzer Engineering Laboratories SEL-700G or approved equal by Basler Electric (may require more than one relay to provide all required relay functions)

2.11 PROTECTIVE RELAY TEST SWITCHES

- A. Provide a factory test switch assembly unit with an adequate number of individual test switches (minimum of 10 switches) for testing and troubleshooting protection relay and instrument transformer circuits in place.
- B. Switches for current transformer circuits shall be make-before-break (shorting) type.
- C. Switches handles shall be color coded for ease of identification.
- D. Test switch unit shall be mounted in each power circuit breaker compartment door directly under the protection relay.
- E. Switch units shall be rear connected.
- F. Provide clear cover and test paddle with the same number of points as the test switch (either 10 or 14).
- G. Provide a minimum twelve (12) year manufacturer’s warranty on the test switch assemblies.
- H. Protective relay test switch units shall be ABB Flexitest FT-1 or FT-14 (based on the number of individual switches required) or approved equal by States or GE Vernova.

2.12 LOCKOUT RELAYS

- A. Provide a solenoid-trip reset switch (lockout relay), ANSI Device 86, in the door of the switchgear circuit breaker compartment for both the utility source and generator sources.
- B. The lockout relays (LORs) shall be operated by their respective protective relays and shall open their respective circuit breakers, either 52N or 52E. Operation of the generator breaker LOR shall also disconnect the AC voltage input power to the voltage regulator from the permanent magnet generator (PMG) on the generator.
- C. Switch contacts shall be rated 30 amperes, 125VDC and 120VAC.
- D. LORs shall be manual reset type; Electros witch Series 24 or approved equal by Instrument Transformers, Inc. or GE Multilin.
- E. Provide a separate capacitor trip device for each LOR.

2.13 CAPACITOR TRIP DEVICES

- A. Provide separate capacitor trip devices for each tripping each of the two (2) power circuit breakers and each of the two (2) corresponding lock out relays (LOR). Four (4) capacitor trip devices are required.
- B. Capacitor trip devices shall be automatic charging type to provide circuit breaker and LOR trip power.
- C. Capacitor trip devices shall be provided with rechargeable 1.2-volt nickel-cadmium (NiCad) battery cells that, when fully charged, will maintain a charge adequate for breaker and LOR tripping for a minimum of 3 days after interruption of the AC source.
- D. In normal operation the batteries shall be trickle charged from the AC voltage source.
- E. Capacitor charge current shall be limited to protect the control power system from a large current in-rush.
- F. Capacitor trip devices shall be self-protected from short circuit damage on the output.
- G. Capacitor trip devices shall include a unit mounted push button and LED to indicate whether the trip device is operationally ready.
- H. Capacitor trip devices shall meet the following specifications at 25°C:
 - 1. Input.....120VAC ($\pm 10\%$ Max)
60Hz
Maximum 10VA burden continuous
 - 2. Output.....169VDC (with nominal AC power)
64 joules at nominal voltage and capacitance
 - 3. Charging Time.....8 seconds, 0 to 90% of nominal output voltage,
60Hz
 - 4. Operating Temperature.....-30°C to +50°C
 - 5. Capacitance.....4500 $\mu\text{F} \pm 20\%$

- I. Capacitor trip devices shall be Instrument Transformers, Inc. Model CTDB-6 or approved equal by ABB or Basler.

2.14 CIRCUIT BREAKER CONTROL SWITCHES

- A. Provide a circuit breaker control switch for each of the two (2) power circuit breakers.
- B. Circuit breaker control switch shall have fixed pistol grip handle, momentary contacts, 3-position with “TRIP” to the left and “CLOSE” to the right, spring return to center from both sides and with a fourth “TRIP – PULL OUT” position to the extreme left having maintained contacts.
- C. Switch contacts shall be rated 30 amperes, 125 VDC or 120 VAC.
- D. Circuit breaker control switch shall be Electros witch Series 24 or approved equal by Instrument Transformers, Inc.

2.15 INDICATING LIGHTS AND CONTROL DEVICES

- A. Provide indicating status pilot lights as specified herein to indicate power circuit breaker position and spring charge status, ATS control power availability, ATS source availability, source serving the load, controls not in auto condition,
- B. Pilot lights for power circuit breaker position and status shall be mounted on the outer door of each circuit breaker compartment directly above the breaker control switch.
- C. All other pilot lights and specified control push buttons and selector switches shall be mounted the outer door of the auxiliary section of the ATS with the ATS controller and power and energy meter.
- D. Pilot light units shall be NEMA Type 4/13 (watertight/oiltight), 16 mm for circuit breaker position and status lights and 22, 30 or 30.5 mm for all other pilot lights, round metal, panel mounted, 120 volts AC, push-to-test, full voltage type using high-intensity LED type lamps with plastic color lens cap. Each pilot light shall be identified with manufacturer’s collar legend plate. LED lamps shall be replaceable by removal of the color cap. A single lamp test push button for all pilot lights is acceptable in lieu of a push-to-test function on each individual pilot light.
- E. Push button units shall be NEMA Type 4/13 (watertight/oiltight), 22, 30 or 30.5 mm round metal, panel mounted, with fully guarded or flush black spring-loaded momentary push button.
- F. Selector switches shall be NEMA Type 4/13 (watertight/oiltight), 22, 30 or 30.5 mm round metal, two or three-position (as indicated), maintained contact, panel mounted with the Standard Operator.
- G. Each pilot light, push button, and selector switch shall be identified with the device manufacturer’s engraved collar legend nameplate having the wording as shown on the Drawings or as specified herein to indicate the function of the device.

2.16 SURGE PROTECTION

- A. Surge Arresters: One metal-oxide type heavy-duty, intermediate class surge arrester rated 5.1 kV maximum continuous line-to-ground operating voltage (MCOV) (6 kV RMS Duty

Cycle Voltage rating) shall be provided on each 4.16 kV phase conductor on the line side terminals of both the normal source and emergency source circuit breakers and shall be mounted in the cable compartment at the bottom of the switchgear.

1. Surge arresters shall be fabricated from ESP silicone alloy weathershed material, Hubbell Power Systems – Ohio Brass Type PVI-LP or approved equal by Cooper Power Systems or Eaton.

B. Surge arrestors terminal connections shall be removable.

2.17 ELECTRONIC POWER AND ENERGY METER

A. Provide a microprocessor based electronic power and energy meter (EPM) in the ATS connected to the common load side bus as indicated on the Drawings, to measure as a minimum:

1. Instrumentation
 - a. Current, per phase, total
 - b. Current, demand
 - c. Voltage, per phase (L-L, L-G), total
 - d. Minimum/maximum readings; I, V
 - e. Minimum/maximum readings; I, V, PF, F, W, VAR, VA
 - f. Frequency
2. Power
 - a. Real, reactive and apparent power (W, VAR, VA)
 - b. Power factor, per phase, total
 - c. Real, reactive and apparent power demand
3. Demand methods
 - a. Block interval (sliding, fixed)
4. Energy
 - a. Real, reactive and apparent energy, total (Wh, VARh, VAh)
5. Statistics
 - a. MAX with time stamp and MIN with time stamp
 - 1) Each phase of V and I
 - 2) Total of W, VAR, VA, PF and Hz
 - 3) Demand of I1, I2, I3, W, VAR and VA
6. Communications
 - a. RS-485, Modbus RTU/ASCII, KYZ output
 - b. DNP3.0
7. Realtime clock
 - a. Year, month, date, hour, minute, second
8. Ethernet

- a. Modbus TCP/IP (RJ45) or BACnet/IP (to be selected as part of shop drawing submittal process)
- 9. Revenue accuracy
 - a. ANSI C12.20 (0.5 or 0.2%)
- 10. Environmental
 - a. Operating temperature: -13°F to +158°F
 - b. Storage temperature: -40°F to +185°F
 - c. Relative humidity: 5% to 95%, noncondensing
 - d. Protection level: IP54 (front), IP30 (cover)
- B. EPM shall have 4" minimum LCD backlit display and "soft" keys for function selection.
- C. Provide control power transformer with input disconnect switch and primary and secondary fusing for 120VAC input power to the EPM per the Instrument Transformer article in this section.
- D. Provide 5A window type current transformers with shorting-type terminal blocks for the EPM current inputs per the Instrument Transformer article in this section.
- E. Provide three (3) 2400VAC to 120VAC potential transformers for voltage inputs to the EPM per the Instrument Transformer article in this section.
- F. Electronic power and energy meter shall be Schneider Electric PowerLogic PM8000 Series or approved equal by Siemens, Eaton or Satec.

2.18 CONTROL WIRING

- A. All ATS switchgear control wiring shall be Type SIS, flexible 41-strand minimum, copper, 90°C dry, 600-volt single conductor wire, minimum size 14 AWG, except where larger size wire is required. All wire shall be UL Listed, flame-retardant and meeting the VW-1 vertical flame test.
- B. All electrical instruments and devices installed in a vertical section shall be factory wired to terminal blocks located inside the vertical section. Interconnecting wiring from exterior components to the switchgear, as well as interconnecting wiring within the switchgear, between vertical sections, shall terminate at the terminal blocks.
- C. Terminal blocks shall be provided for the connection of all interconnection wiring leaving the ATS switchgear and going to all remote devices.
- D. A minimum of ten percent (10%) spare terminal blocks shall be provided in each vertical section.
- E. All terminal blocks shall contain a white or very light gray center mounted removable marking strip marked in accordance with the detailed connection diagrams.
- F. Conductors shall be identified at each termination by marking with a number to correspond with the diagrams. Identification tags shall be made of oil-resistant material. If wrap-type adhesive strips are used, they shall be a minimum of 1-3/8 inches long. Sleeve-type tags shall be undersized so that they will not slip off the conductor if the conductor is removed

from its termination point. Identification tags shall be W.H. Brady Company Type B-700, or T & B WSL Series, or approved equal.

- G. The wiring between the swing-out interior door and the interior of each vertical section shall be bundled and properly laced, with sufficient slack to permit full opening of the door without damaging the wire bundle. All wires between the door and the panel interior shall terminate at the terminal strip inside the section enclosure.
- H. All control wiring shall enter/exit the ATS switchgear through the top.

2.19 FABRICATION

- A. Construction: Each equipment bay shall be a separately constructed cubicle assembled to form a rigid freestanding unit with sufficient bracing to minimize distortion. Minimum sheet metal thickness shall be 11-gauge steel on all exterior surfaces. Adjacent bays shall be securely bolted together to form an integrated rigid structure. The rear covers shall be removable to assist installation and maintenance of bus and cables.
- B. The metal-clad switchgear shall be fully assembled, inspected and tested at the factory prior to shipment.

2.20 FACTORY FINISH

- A. All steel parts, shall be cleaned and an iron phosphate pre-treatment applied prior to paint application.
- B. Paint color shall be ANSI-49 medium gray or ANSI-61 light gray for the exterior and ANSI-70 white for the interior; TGIC polyester powder applied electro statically through air. Following paint application, parts shall be baked to produce a hard durable finish. The average thickness of the paint film shall be 3.0 mils. Paint film shall be uniform in color and free from blisters, sags, flaking and peeling.
- C. Adequacy of paint finish to inhibit the buildup of rust on ferrous metal materials shall be tested and evaluated per paragraphs 5.2.8.1-7 of ANSI C37.20.2. Salt spray withstand tests in accordance with ASTM #D-1654 and #B-117 shall be periodically performed on a sample to confirm conformance with the corrosion resistance standard of at least 600 hours minimum.

2.21 MICROPROCESSOR BASED CONTROLLER

- A. The transfer switch shall be equipped with a microprocessor-based control panel. The control panel shall perform the operational and display functions of the transfer switch. The display functions of the control panel shall include ATS position and source availability.
- B. The control panel shall be provided with menu driven display screens for transfer switch monitoring, control and field changeable functions and settings.
- C. The controller shall direct the operation of the transfer switch. The controller's sensing and logic shall be controlled by a built-in microprocessor for maximum reliability, minimum maintenance and the ability to communicate via an Ethernet connection through an internally mounted communications module.

- D. Voltage sensing shall be true RMS type and shall be accurate to $\pm 1\%$ of nominal voltage. Frequency sensing shall be accurate to $\pm 0.2\%$. Time delay settings shall be accurate to $\pm 0.5\%$ of the full-scale value of the time delay. The panel shall be capable of operating over a temperature range of -20°C to 60°C and a storage temperature from -55°C to 85°C .
- E. The controller shall be enclosed with a protective cover and be mounted separate from the transfer switch unit for safety and ease of maintenance. The digital display shall be accessible without opening the enclosure door.
- F. Sensing and control logic shall be provided on multi-layer printed circuit boards that are opto-isolated from electrical noise.
- G. Interfacing relays shall be industrial grade plug-in type with dust covers.
- H. A common terminal block shall be provided for all field wiring connections.
- I. The controller shall be connected to the transfer switch by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the controller to be disconnected from the transfer switch for routine maintenance.
- J. The controller shall meet or exceed the requirements for Electromagnetic Compatibility (EMC) as follows:
 - 1. EN 55011 Emission Standard – Group 1, Class A
 - 2. EN 61000-4-2 Electrostatic Discharge (ESD) Immunity
 - 3. EN 61000-4-3 Radiated RF Electromagnetic Field Immunity
 - 4. EN 61000-4-4 Electrical Fast Transient (EFT) Immunity
 - 5. EN 61000-4-5 Surge Transient Immunity
 - 6. EN 61000-4-6 Conducted Radio-Frequency Field Immunity
 - 7. EN 61000-4-11 Voltage Dips, Interruption and Various Immunity
 - 8. CISPR 11 Conducted RF Emissions and Radiated RF Emissions
- K. Controller Display and Keypad
 - 1. A backlit four-line, 20-character LCD display and keypad shall be an integral part of the controller for continuous viewing all available data and setting desired operational parameters. Operational parameters shall also be available for viewing and limited control through the serial communications input port. The following parameters shall only be adjustable via DIP switches on the controller.
 - a. Nominal line voltage and frequency
 - b. Single or three phase sensing
 - c. Operational parameter protection
 - d. Transfer operating mode configuration, (open transition, closed transition or delayed transition)
 - 2. To appropriately trained operators, all instructions and controller settings shall be easily accessible, readable, and accomplished without the use of codes, calculations, or instruction manuals.

3. The programming functions shall be pass code protected.
 4. Provide touch pad test switch with Fast Test/Load/No Load positions to simulate a normal source failure.
- L. The following features shall be built-in to the controller, but shall be capable of being activated through keypad programming or the serial communications port when required by the User:
1. Provide the ability to select “commit/no commit to transfer” to determine whether the load should be transferred to the emergency generator if the normal source restores before the generator is ready to accept the load.
 2. *In-Phase Monitor*: An in-phase monitor shall be provided in the controller to control transfer so that motor load inrush currents do not exceed normal starting currents and shall not require external control of power sources. The in-phase monitor shall be specifically designed for and be the product of the ATS manufacturer.
 3. The controller shall be capable of accepting a normally open contact that will allow the transfer switch to function in a non-automatic mode using an external control device.
 4. *Engine Exerciser*: The controller shall provide an internal load/no-load engine exerciser. The engine exerciser shall allow the user to program up to seven different exercise routines. For each routine, the user shall be able to:
 - a. Enable or disable the routine
 - b. Enable or disable transfer of the load during routine
 - c. Set the start time; time of day, day of the week, week of the month (1st, 2nd, 3rd, 4th, alternate or every)
 - d. Set the duration of the run

At the end of the specified duration the switch shall transfer the load back to the normal source and run the generator for the specified cool down period. A 10-year life battery that supplies power to the real time clock in the event of a power loss will maintain all time and date information.
 5. *System Status*: The controller LCD display shall include a “System Status” screen which shall be readily accessible from any point in the menu by depressing the “ESC” key a maximum of two times. This screen shall display a clear description of the active operating sequence and switch position. For example:

Normal Failed
Load on Normal
TD Normal to Emerg
2min15

Controllers that require multiple screens to determine system status or display “coded” system status messages, which must be explained by references in the operator’s manual, are not acceptable.
 6. *Self-Diagnostics*: The controller shall contain a diagnostic screen for the purpose of detecting system errors. This screen shall provide information on the status input signals to the controller which may be preventing load transfer commands from being completed.

7. Data Logging: The controller shall have the ability to log data and to maintain the last 99 events, even in the event of total power loss. The following events shall be time and date stamped and maintained in a non-volatile memory:
 - a. Event Logging
 - 1) Date and time and reason for transfer normal to emergency
 - 2) Date and time and reason for transfer emergency to normal
 - 3) Date and time and reason for engine start
 - 4) Date and time engine stopped
 - 5) Date and time emergency source available
 - 6) Date and time emergency source not available
 - b. Statistical Data
 - 1) Total number of transfers
 - 2) Total number of transfers due to source failure
 - 3) Total number of days controller is energized
 - 4) Total number of hours both normal and emergency sources are available
 - 5) Date and time emergency source available

2.22 VOLTAGE, FREQUENCY AND PHASE ROTATION SENSING

- A. Voltage and frequency on both the normal and emergency sources (as noted below) shall be continuously monitored, with the following pickup, dropout, and trip settings capabilities (values shown as % of nominal unless otherwise specified).

<u>Parameter</u>	<u>Sources</u>	<u>Dropout/Trip</u>	<u>Pickup/Reset</u>
Undervoltage	N & E, 3Φ	70 to 98%	85 to 100%
Overvoltage	N & E, 3Φ	102 to 115%	2% below trip
Underfrequency	N & E	85 to 98%	90 to 100%
Overfrequency	N & E	102 to 110%	2% below trip
Voltage Unbalance	N&E	5 to 20%	1% below dropout

- B. Repetitive accuracy of all settings shall be within +/-0.5 over an operating temperature of -20°C to 60°C.
- C. Voltage and frequency settings shall be field adjustable in 1% increments either locally with the display and keypad or remotely via serial communications port access.
- D. Source differential sensing shall be provided for the closed transition operating mode. The sensor shall enable transfer/re-transfer between live sources in the closed transition mode only when the two sources have a maximum voltage differential of 5%, frequency differential of 0.2 Hz and are within 5 electrical degrees. If the normal source becomes unacceptable the controller shall automatically initiate an open transition (break-before-make) load transfer to the emergency source.
- E. Closed transition transfer shall be initiated when operating the transfer test selection switch. Retransfer to the normal source shall operate in closed transition mode at the conclusion of transfer test time delay after the test mode selector switch is moved out of the Test position.

- F. Closed transition transfer shall be accomplished with no power interruption and without altering or actively controlling the standby generator set.
- G. The transfer switch controls shall contain the following multiple levels of protection against extended parallel times in excess of 100 ms by taking the following action:
 - 1. If the Normal or Emergency main contacts both remain closed after a preset time delay, the controller shall attempt to return the transfer switch to “safe” state by removing paralleled condition.
 - a. The controller shall open the last set of contacts that closed to remove the overlap condition.
 - b. The controller is locked out from any further automatic operation.
 - c. The “TS Locked Out” indicator (Red LED) shall be illuminated.
 - d. The operation shall remain locked out until the “TS Locked Out” push – button is reset.
 - 2. If the main contacts still remain paralleled after the transfer switch controller action described in paragraph 2.4 G, a second independent extended parallel alarm timer shall then operate an output relay with two (2) Form C contacts to alarm the extended overlap condition and/or shunt trip either the normal or emergency source breaker through a customer connected circuit to the breaker.
- H. The controller shall be capable, via the keypad or through the serial communications port, of sensing the phase rotation of both the normal and emergency sources. The source shall be considered unacceptable if the phase rotation is not the preferred rotation selected (ABC or CBA).
- I. Source status screens shall be provided for both normal and emergency to provide digital readout of voltage on all three phases, frequency and phase rotation. Single-phase sensing on both the normal and the emergency sources shall be provided.
- J. The controller shall include a user selectable algorithm to inhibit retransfer to the normal (utility) source upon detection of a single phasing condition until a dedicated timer expires, the alternate source fails, or the normal source fails completely and is restored during this time delay period. The time delays associated with this feature shall be adjustable by the user through the controller keypad and LCD display.

2.23 TIME DELAYS

- A. A time delay shall be provided to override momentary normal source outages and delay all transfer and engine starting signals, adjustable 0 to 6 seconds. It shall be possible to bypass the time delay from the controller user interface. Initial setting for this time delay shall be 2 seconds. Capability shall be provided to extend the time delay to 60 minutes by means of an external 24 VDC power supply.
- B. A time delay shall be provided on transfer from normal to emergency, adjustable from 0 to 60 minutes, for controlled timing of transfer of loads to emergency. It shall be possible to bypass the time delay from the controller user interface. Initial setting for this time delay shall be 1 seconds.

- C. An adjustable time delay of 0 to 6 seconds to override momentary emergency source outage to delay all retransfer signals during initial loading of engine generator set. Initial setting for this time delay shall be zero (0).
- D. Two (2) time delay modes shall be provided on re-transfer to normal. One time delay shall be for actual normal power failures and the other shall be for the test mode function. The time delays shall be independently adjustable from 0 to 60 minutes. If the emergency source fails during the retransfer time delay and the normal source is acceptable, the transfer switch controls shall automatically bypass the time delay and immediately retransfer to the normal position. Initial setting for this time delay for normal power failures shall be 30 minutes and for test mode shall be 30 seconds.
- E. Time delay on transfer in either direction in the center-off position, programmable 0-2 minutes, factory set at 0 seconds.
- F. A cooldown time delay shall be provided on shutdown of engine generator, Adjustable 0 to 60 minutes. Initial setting for this time delay shall be 0 if engine cooldown timer is included in the generator control panel. Otherwise, the initial setting for this time delay shall be 5 minutes.
- G. A time delay activated output signal shall also be provided to drive an external relay(s) for selective load disconnect control. The controller shall have the ability to activate an adjustable 0 to 5 minutes time delay in any of the following modes:
 - 1. Prior to transfer only
 - 2. Prior to and after transfer
 - 3. Normal to emergency only
 - 4. Emergency to normal only
 - 5. Normal to emergency and emergency to normal
 - 6. All transfer conditions or only when both sources are available
- H. If the alternate source is not accepted within the configured Failure to Accept time delay, the common alert indication shall become active.
- I. The controller shall also include the following built-in time delay for closed transition operation: 1-to-5-minute time delay on failure to synchronize normal and emergency sources prior to closed transition transfer. Initial setting shall be 5 minutes.
- J. All adjustable time delays shall be field adjustable in 1 second increments, except the extended parallel time, which shall be adjustable in 0.01 second increments. Timing adjustments shall be executed using the LCD display and keypad or with a remote device connected to the serial communications port. The time delay value displayed on the LCD display or remote device shall be the remaining time until the next event occurs.
- K. Extended Parallel Relay: Provide a separate, stand-alone timing relay, adjustable from 0.1 to 2.0 seconds maximum, to monitor for an extended parallel condition of both power sources during closed transition operation with two (2) Form C output contacts that change state when the time expires. One of these contacts will be used to break the parallel condition by tripping the emergency source breaker open. Initial setting shall be 2 seconds. It shall not be possible to set the time delay on this relay to longer than 2.0 seconds.

2.24 SEQUENCE OF OPERATION

- A. The ATS shall incorporate adjustable three phase under and over-voltage and three phase under and over-frequency sensing on the normal source.
- B. When the voltage on any phase of the normal source is reduced to 85% of rated voltage for 10 seconds (programmable), a pilot contact shall close to initiate starting of the generator.
- C. The ATS shall incorporate adjustable three phase under and over-voltage and three phase under and over-frequency sensing on the emergency source.
- D. When the generator is delivering not less than 90% of rated voltage and 95% of rated frequency, the load shall be transferred to the emergency source after an adjustable time delay. During test or other source to source transfer, 95% voltage and frequency, phase rotation and angle shall be verified.
- E. When the normal source has been restored to not less than 95% and not more than 105% of nominal voltage on all phases, proper phase rotation is verified, and after a time delay of 0 to 30 minutes (adjustable), the load shall be transferred to the normal source in a closed transition operation. The generator shall run unloaded for 5 minutes (adjustable) and then shut down. The generator shall be ready for automatic operation upon the next failure of the normal source.
- F. If the engine generator should fail while carrying the load, open transition retransfer to the normal source shall be made instantaneously upon restoration of proper voltage (90%) on the normal source.
- G. A synch check relay shall be provided for closed transition operation. The monitor shall control transfer and retransfer between live sources and operate by sensing the zero-voltage point. It shall be factory set to accomplish transfer within 5 electrical degrees and +/-5% voltage differential. An alarm shall be provided to indicate if closed transition transfer is not accomplished within a preset time period due to a failure to meet operational parameters.
- H. Closed transition transfer in conjunction with over/under-voltage, phase rotation and angle sensing shall be accomplished when both sources are within specified parameters without any power interruption and without altering the speed or actively controlling the generator.
- I. During closed transition operation, the control circuit shall monitor interconnect time. Should connection exceed 100 ms, the set of power contacts just closed shall be reopened and an alarm circuit shall be energized. If the main contacts fail to open, an independent 0.1 to 2 second (adjustable) timing relay that began counting down when the parallel condition began and will close its output contact, upon expiration of its time setting, to trip the ATS emergency source circuit breaker open to end the paralleling condition. The anti-parallel fail-safe function shall be controlled by a dedicated auxiliary relay inside the transfer switch enclosure.

2.25 ACCESSORIES

- A. The automatic transfer switch shall include the following items as a minimum.
 - 1. Voltage sensitive relays for full voltage protection

2. A sync check relay shall be provided to ensure the load is transferred between sources (normal to emergency or emergency to normal) only when they are in phase
3. Two (2) auxiliary 120V, 10A, form “C” contacts which change state depending on the voltage source used
4. 2PDT auxiliary 120V, 10A contacts which change state when the emergency source voltage is present at the transfer switch terminals
5. 2PDT auxiliary 120V, 10A contacts which change state when the normal source voltage is present at the transfer switch terminals
6. One (1) auxiliary 120V, 10A form “C” contact which changes state on “normal” line failure
7. A timed auxiliary contact (1 N.C.) adjustable 0-60 seconds shall be provided to allow motor loads to be disconnected prior to transfer in either direction
8. Pilot lights shall be provided on the exterior side of the enclosure door and shall be energized by controller outputs to indicate the following:
 - a. Green to indicate switch is in NORMAL power position
 - b. Red to indicate switch is in the EMERGENCY power position
 - c. White to indicate NORMAL power source is available
 - d. Amber to indicate EMERGENCY power source is available
9. A lamp test push button shall be provided on the exterior side of the enclosure door, which shall test all pilot lights simultaneously. Push-to-test pilot lights may be provided in lieu of a single lamp test push button.
10. Automatic-Manual Selector Switch: A two-position key operated selector switch having maintained AUTOMATIC position and maintained MANUAL position shall be provided to allow for automatic operation or fully manual mode operation of the ATS. When the switch is placed in the MANUAL position, the Normal and Emergency Source Circuit Breakers may then be operated using the circuit breaker control switches on the front of each circuit breaker compartment. This provides electrically interlocked operation to ensure that both circuit breakers cannot be closed simultaneously. Additionally, the Normal or Emergency Source Circuit Breakers may be tripped open by the circuit breaker control switches at any time during Automatic or Manual operation. A red or amber “Controls Not in Auto” LED pilot light shall be provided to indicate that the automatic operating mode has been disabled.
11. Transfer Switch Test Switch: A two-position key operated selector switch having maintained NORMAL or AUTO position and maintained TEST position, with nameplates indicating TEST and NORMAL or AUTO mounted on the exterior side of the enclosure door.
 - a. The “normal” or “auto” mode shall be for placing the transfer switch control circuitry in normal operation as specified herein.
 - b. The “test” mode shall be for manual simulation of “normal” power source failure or outage (as herein specified in Article 2.22 of this Section).
 - c. Switching the selector switch back to the “normal” or “auto” mode position from the “test” mode position shall manually simulate the return

of the “normal” power source and shall activate all phases of operation associated therewith.

12. Engine-Generator Set Starting Contact: A SPDT contact, rated 5 amps at 30 VDC, shall be provided for a low-voltage engine start signal. The start signal shall prevent dry cranking of the engine by requiring the generator set to reach proper output and run for the duration of the cool down setting, regardless of whether the normal source restores before the load is transferred. Provide continuous engine start circuit integrity monitoring per NEC 700.10(D)(4) such that an open or short in the engine start circuit wiring shall cause the engine-generator to start.
13. Provide a momentary push button to bypass the time delays on transfer and retransfer and programmable commit/no commit control logic.
14. Provide terminals for remote test/peak shave operation and transfer inhibit to the emergency source.
15. External DC Power Supply Provisions: Provide provisions for connection of an external 24 VDC power supply to allow the LCD and the door mounted control indicators to remain functional when both power sources are dead.
16. Keyed Mechanical Interlock on Emergency Source Circuit: Provide keyed mechanical interlock on emergency circuit breaker to prevent closing of the breaker, both mechanically and electrically, unless the dead-break elbow access compartment door on the Section 263290 – Medium-Voltage Generator Connection Cabinet is closed thereby releasing the interlock key needed to enable closing of the emergency source breaker both mechanically and electrically. A keyed mechanical interlock, keyed the same as the emergency breaker keyed interlock, shall be provided to the supplier of the generator connection cabinet for them to factory install on the generator connection cabinet dead-break elbow access door. The mechanical configuration and operation of the interlock bolt shall be as specified by the supplier of the generator connection cabinet for compatibility with their equipment.

2.26 COMMUNICATIONS

- A. Provide all hardware and software required for Modbus TCP/IP or Modbus RTU (to be determined at time of shop drawing submittal review) communications between the ATS and the Owner’s existing Schneider Electric StruxureWare building automation system (BAS). Coordinate with Specification Section 230900 – Instrumentation and Control for HVAC requirements.
- B. All communications hardware shall be UL 1008A listed and labeled.
- C. Include control power transformer or power supply as required to power the communications hardware.
- D. Hardware shall be capable of operating in ambient temperatures from -4°F to 140°F.
- E. Provide real-time monitoring and data logging of the power source status and the switch position of the ATS.
- F. Provide pick-ups, drop-outs, time delays, engine exerciser schedule and feature settings for the ATS.
- G. Provide NFPA test and utility outage information to meet NFPA compliance requirements.

- H. The communications module shall include the following features:
1. Email notifications and SNMP traps of selectable events and alarms may be sent to a mobile device or PC.
 2. Modbus TCP/IP, SNMP, HTTP, SMTP open protocols shall be simultaneously supported.
 3. Web app interface requiring user credentials to monitor and control the transfer switch supporting modern smart phones, tablets and PC browsers. User shall be able to view the dynamic on-line, ATS controls status, alarms, metering, event logging as well as settings.
 4. Secure access shall be provided by requiring credentials for a minimum of 3 user privilege levels to the web app.
 - a. Monitor (view only)
 - b. Control (view and control)
 - c. Administrator (view, control and change settings)
 5. 128-bit AES encryption standard shall be supported for all means of connectivity.
 6. Allow for the initiating of transfers, retransfers, bypassing of active timers and activating/deactivating of engine start signal shall be available over the embedded webpage and to the transfer switch vendor's monitoring equipment.
 7. An event log displaying a minimum of three hundred (300) events shall be viewable and printable from the embedded webpages and accessible from supported open protocols.
 8. Four (4) 100Mbps Ethernet copper RJ-45 ports, two (2) serial ports, termination dipswitches and LEDs for diagnostics.
 9. DIN rail mountable.

2.27 NAMEPLATES

- A. All devices mounted on the transfer switch enclosure door, as well as individual items mounted inside the enclosure, shall be provided with a nameplate to show the identification and/or function of the device or item in accordance with the equipment manufacturer's drawings and wiring diagrams.
- B. Engraved nameplates, mounted on the face of the assembly, shall be furnished for the switchgear as indicated on the Drawings in accordance with Section 260553 – Identification for Electrical Systems. Nameplates shall have white characters on a red background. Characters shall be 3/16-inch high, minimum.
- C. Furnish master nameplate for the switchgear lineup giving information in accordance with IEEE C37.20.2, Section 7.4.1.

2.28 POWER CIRCUIT BREAKER ACCESSORIES

- A. Provide the following items with the ATS switchgear for testing, inspection, maintenance and/or operation of the power circuit breakers:
 1. Maintenance tool for slow closing the breaker outside the compartment, manually charging the breaker closing spring and manually opening the shutter.

2. Levering crank for moving the breaker between the test and connected positions.
3. Test jumper for electrically operating the breaker while out of its compartment.
4. Circuit breaker test cabinet for testing the electrically operated power circuit breakers when removed from the switchgear.
5. Set of rail extensions and rail clamps, if applicable.
6. Circuit breaker lifting yoke for use with the fixed mounted overhead circuit breaker lifting mechanism.

2.29 APPROVED MANUFACTURERS

- A. The medium-voltage closed-transition automatic transfer switch shall be as manufactured by:
 1. ASCO, 7000 Series
 2. Russelectric Inc., RTSMV Series
 3. Approved equal by Eaton/Caterpillar
- B. The basis of design for the medium-voltage closed-transition automatic transfer switch is the ASCO 7000 Series. Should the Contractor choose to include one of the approved equal manufacturers, he will be responsible for any additional costs resulting from physical changes and/or required accessories to make the equipment work with the existing conditions at the Facility.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The Contractor shall verify NEC clearances as indicated on the Drawings prior to installation. Working space and clearances shall be in accordance with NEC Article 110. Verify UL labeling of the assembly prior to installation.
- B. The Contractor shall follow the installation instructions supplied by the manufacturer.
- C. Rig the ATS assembly into final location and install on level, 3-1/2" high concrete housekeeping pad, with 1" chamfered top edge, per Section 260500 – Common Work Results for Electrical. The pad shall be 2" larger than the ATS enclosure all around as shown on the Drawings and in accordance with Section 260500 – 2.3 – Equipment Pads and Anchor Bolts.
- D. The ATS shall be bolted to the concrete floor using expansion anchor bolts meeting the requirements of Section 260529 – Hangers and Supports for Electrical Equipment. Anchor bolt size, quantity and placement shall be as indicated in the ATS manufacturer's installation instructions for seismic freestanding certification. Anchor bolts shall extend through the concrete housekeeping pad to provide the required embedment in the concrete floor below the housekeeping pad. As a minimum, provide one anchor bolt at each corner with 6" minimum embedment into the concrete floor below the housekeeping pad.
- E. All conduits which terminate in the top of the ATS shall be terminated with an insulated throat, grounding type, liquid tight rigid conduit hub in accordance with Section 260533.13 – Conduit for Electrical Systems. Grounding lug on the lock nut of each conduit hub shall

be connected to the ATS interior ground bus bar in accordance with Section 260526 – Grounding and Bonding for Electrical Systems.

- F. Where a new ATS is to be installed in the same location as an existing ATS, and the existing conductors are indicated to remain in place, extend existing conductors to the appropriate terminals on the new switch if/as required utilizing in-line, long-barrel compression connectors with cold shrink insulating tubes in accordance with Section 260583 – Wiring Connections.
- G. Torque all bolted connections made in the field in accordance with manufacturer's published values using calibrated torque wrench.

3.2 ARC FLASH HAZARD WARNING LABELS

- A. Provide arc flash hazard warning label on all exterior doors of the ATS in accordance with Sections 260553 - Identification for Electrical Systems and 260573 – Protective Device Coordination Study and Arc Flash Risk Assessment.

3.3 FACTORY TESTS

- A. The complete ATS shall be factory tested to ensure proper operation of the individual components and correct overall sequence of operation and to ensure that the operating transfer time, voltage, frequency and time delay settings are in compliance with the specification requirements.
- B. The equipment shall be factory tested to simulate a complete and integrated system. The circuit breakers supplied shall be installed in their actual positions and electrically and mechanically tested. A narrative of the system operation shall be provided and shall be utilized when testing the equipment. Copies of the test reports shall be provided.
- C. Circuit breaker test reports shall be provided.
- D. Circuit breaker test reports [shall] [shall not] be provided
- E. All tests shall comply with applicable ANSI standards.
 - 1. Dielectric Test: ANSI C37.20 Para. 5.3.1, latest revision.
 - 2. Mechanical Test: ANSI C37.20 Para. 5.3.2, latest revision.
 - 3. Grounding of Instrument Transformer Case Test: ANSI C37.20 Para. 5.3.3, latest revision.
 - 4. Electrical Operation & Control Wiring Test: ANSI C37.20 Para. 5.3.3, latest revision.
 - 5. Polarity Test: ANSI C37.20 Para. 5.3.4.3, latest revision.
 - 6. Sequence Test: ANSI C37.20 Para. 5.3.4.4, latest revision.

3.4 FIELD TESTING AND COMMISSIONING

- A. Field testing and commissioning shall be completed by a factory trained field service technician.
- B. All items shall be visually inspected to ascertain that each item is not damaged and is in proper working condition.

- C. Final acceptance testing for the circuit breakers and switchgear shall include phase-to-phase and phase-to-ground resistance measurements (meggering) of all power voltage terminals, including the three interrupters on each circuit breaker element. The resistance reading between each terminal and ground shall be a minimum of 200 megohms.
- D. All protective relays shall be properly set in accordance with instructions from the Missouri PE retained to complete the Section 260573 – Protective Device Coordination Study and Arc Flash Risk Assessment work and all protective relays shall be calibrated and tested to ensure correct and proper operation.
- E. The complete transfer switch shall be tested to ensure proper operation.
- F. The normal and emergency power supplying the automatic transfer switch shall be tested for comparable phase relationships.
- G. The automatic transfer switch shall have its normal power interrupted in order to ensure fully automatic shifting of power from its normal source to emergency power.
- H. The transfer switch shall be tested for operation below 85% rated voltage. Also test the contacts and signal that activates the diesel-electric generator set and confirm the closing of the emergency contacts when the generator is up to 90% rated voltage.
- I. All test switches and pilot lights shall be tested for correct operation and sequence.
- J. Verify proper operation of the Modbus TCP/IP or Modbus RTU communications interface with the Owner's existing Schneider Electric StruxureWare BAS. Coordinate with the BAS Contractor.
- K. The ATS shall be tested for proper operation in both the automatic and fully manual modes of operation.
- L. All emergency power system tests shall be tested in the presence of and approved by the Construction Representative.
- M. All discrepancies shall be immediately corrected by the Contractor, either by repairing or replacement, to the satisfaction of and at no cost to the Owner. Final payment of the Contract shall be withheld until this has been accomplished.
- N. Any changes made during startup and commissioning of the equipment shall be included on the "as-built" record drawings to be submitted within two weeks of the successful completion of startup and testing.
- O. The Contractor shall submit to the Designer complete information on the circuit breakers regarding regular inspection and/or maintenance, if required, and shall state if an outage is required when performing such procedures.
- P. A field startup report shall be furnished for the medium-voltage closed-transition automatic transfer switch that indicates all checks and tests and the final setting of all adjustable setpoints and time delays.

3.5 TRAINING

- A. Provide on-site training in accordance with Section 017900 – Demonstration and Training to instruct the Owner's personnel in the proper operation and routine maintenance of the

Upgrade Generator Controls & Transfer Switch, Power Plant
Moberly Correctional Center, Moberly, Missouri

C1920-01

equipment. Review operation and maintenance manuals, parts manuals and emergency service procedures.

- B. The training shall be conducted by a manufacturer's qualified representative, after completion of the acceptance testing, and shall consist of instruction on the assembly, circuit breakers, controls, operator interface, power and energy meter operation and all other major components. The training session shall be video recorded by the Contractor in accordance with Section 017900 – Demonstration and Training, and the video file uploaded to the Missouri OA FMDC project management website, Trimble (fka eBuilder).

END OF SECTION 263623

SECTION 263623 – MEDIUM-VOLTAGE AUTOMATIC TRANSFER SWITCHES

ATTACHMENT 1

DOCUMENT C0 – Generator Connection Request Form

Document

C0

Use for:

Connection of Electric Generation
that will operate with an
Open Transition (Category 1) between the Ameren System and
the Generator
or operate with a
Synchronized Closed Transition (Category 2) between the
Ameren System and the Generator of Less than 100
Milliseconds

- Following is the cover letter, connection request form, and technical requirements for generators that operate in either an open transition with Ameren or a synchronized closed transition with Ameren for a duration of less than 100 milliseconds.
- Note that no connection agreement is required.
- There is no generator size limitation for this type of connection.
- Press F11 to enter information into the gray boxes.

[Date]

[Name]

[Company]

[Address] [City, State, Zip]

Re: [Title of Connection Request]

Dear :

Thank you for contacting Ameren regarding your plans to connect backup generation located at [describe proposed location] in [name of state] . The attached documents reflect the process for connecting generation that falls under one of two categories:

- A Category 1 generator only operates when there is an open transition between the Ameren electric system and the generator.
- A Category 2 generator operates with a synchronized closed transition between the Ameren electric system and the generator for no more than 100 milliseconds.

Generally, Ameren requires that customers interconnecting their electric generator to the electric distribution system fund an interconnection study performed by Ameren and then enter into an interconnection agreement regarding the design, operation and testing of the interconnection facilities. However, Ameren will not require generators falling under one of the two categories above to fund such a study or enter into an interconnection agreement, provided the equipment owner (“Customer”) abides by the conditions and requirements outlined in the following two documents, both attached hereto:

- Generator Connection Request Form (Section E) – Outlines the requirements regarding the use, testing and documentation of the generator installation; and
- Specifications and Requirements for the Connection of Electric Generation – Outlines the operating requirements of the generator installation and associated transfer switch equipment.

In addition, Ameren will not impose its standby service tariff on the Customer if the generator unit is installed for emergency operation and the time duration of the closed transition is less than 100 milliseconds.

The Customer must submit the documentation required as soon as available. Upon receiving this information from the Customer, Ameren will review and provide any applicable comments to the Customer. Comments from Ameren may require modifications and resubmission of the documentation.

In order to formally begin the connection process, the Customer must submit the completed Generator Connection Request Form attached hereto.

We are available to meet either at the generator site or at one of our central or division offices to discuss your project prior to beginning the application and approval process. This will allow us to become more familiar with your generation plans and allow you to present any questions or concerns you may have.

Please direct all inquiries to:

Name of Ameren Contact
Ameren Corporation
MC
P.O. Box 66149
St. Louis, MO 63166-6149

Or you can contact me at Phone if you have any questions.

We look forward to working with you on this project.

Sincerely,

Name of Ameren Contact

Generator Connection Request Form
for the
Connection of Electric Generation
that will operate with an
**Open Transition (Category 1) between the Ameren System and
the Generator**
or operate with a
**Synchronized Closed Transition (Category 2) between the
Ameren System and the Generator of Less than 0.1 Seconds**

A. Customer Information

Name: _____ James Harms _____
Mailing Address: Moberly Correctional Center, 5201 South Morley St. _____
City: _____ Moberly _____ State: MO Zip Code: 65270 _____
Service/Street Address (if different from above): _____
City: _____ State: _____ Zip Code: _____
Daytime Phone: 660-263-7334 Fax: _____ E-Mail: James.Harms@doc.mo.gov
Emergency Contact Phone: 573-338-0832 _____
Company Account No. (from Utility Bill): 8560006438 _____

B. Customer's Generator & Transfer Switch System Information

Manufacturer Nameplate AC Power Rating: 1450 kW and Voltage: 4.16Y/2.4k V.
Diesel-engine-driven emergency standby generator set with indoor 4.16kV
System Type: (describe) closed-transition automatic transfer switch _____
Service/Street Address: 5201 South Morley St., Moberly, MO 65270 _____
Transfer Switch Equipment Manufacturer: TBD After Contract Award to Electrical Contractor
Basis of Design is ASCO Series 7000
Transfer Switch Equipment Model No.: (B7ACTM031200U5ZC w/ ACC. 62PL) _____
System Plans & Specifications Attached Must to be included.
Location of Lockable Visible Open/Main Disconnect Device (describe):
New outdoor 4.16kV fusible load interrupter switch next to Ameren metering swgr at SE corner of building.

Existing Electrical Service Capacity: 1200 Amperes Voltage: 4,160 Volts

Service Character: Single Phase _____ Three Phase X _____

C. Installation Information/Hardware and Installation Compliance

Person or Company Installing: TBD - Project will be issued for bid in 4th Qtr 2025 _____

Contractor's License No. (if applicable): _____

Approximate Installation Date: 1st Quarter of 2027 _____

Mailing Address: _____

City: _____ State: _____ Zip Code: _____

Daytime Phone: _____ Fax: _____ E-Mail: _____

Person or Agency Who Will Inspect/Certify Installation: State of Missouri,
Department of Corrections _____

D. Type of Connection (Section E)

Customer is proposing to connect generation that falls under the following category:

_____ Category 1 – Open Transition

X Category 2 – Synchronized Closed Transition of Less than 0.1 Seconds

E. Conditions and Required Testing

For Category 1 and 2 generators:

1. Where the associated Ameren service is less than 600V, install a main service disconnect capable of being padlocked in the open position. Also submit a drawing indicating the nature and physical location of this equipment or device. This equipment shall meet Ameren's Specifications and Requirements for the Connection of Electric Generation attached;

2. Where the associated Ameren service is greater than 600V, install padlockable equipment capable of establishing a “visible disconnect” between the Ameren system and the generator. *A visible disconnect is a switching device that enables one to physically see an open air gap that is created by either the disconnect device itself or by its being drawn out from a “seated” or “racked in” position.* Also submit a drawing indicating the nature and physical location of this equipment or device. This equipment shall meet Ameren’s Specifications and Requirements for the Connection of Electric Generation attached;
3. Provide signage in the immediate vicinity of Ameren’s revenue meter indicating that a generator exists on the premises and that a lockable main service disconnect or lockable visible open disconnect is available. Similarly, provide signage at the disconnect device itself for identification purposes;
4. Agree not to operate the generator in parallel with Ameren’s electric system for purposes of peak shaving, serving normal loads, or testing the capability of the generator to carry electric load. Prolonged operation of the generator in parallel with the utility electric system when it is de-energized creates a safety hazard for utility employees, to the point of being potentially fatal.

For Category 2 generators only:

5. If the generator is equipped with “Fast Transfer Capability,” i.e. relaying and controls that limit the duration of synchronized closed transition between the generator and Ameren’s electric system to less than 100 milliseconds during startup and shutdown of the unit, the generator must demonstrate, through equipment supplier information, that the equipment is designed to achieve the fast transfer in less than 100 milliseconds;
6. Demonstrate that the transfer switch complies with all of Ameren’s Specifications and Requirements for the Connection of Electric Generation, including the provision for a transfer failure scheme, which will cause the opening of one of the sources within two (2.0) seconds of the start of the paralleling condition;
7. Demonstrate that the equipment can achieve the fast transfer by providing an on-site start-up and commissioning test procedure for the fast transfer capability of the hardware. Ameren and the customer shall agree on this procedure as well as on the date and time of the testing. The test procedure shall:
 - A. Provide sufficient notice to Ameren of the fast transfer testing in order to allow Ameren the opportunity to both attend (if desired) and take any operational or safety precautions deemed necessary (contact Name of Ameren Contact at Phone Number);

- B. Test the fast transfer capability per manufacturer's recommendations and verify that the closed transition transfer takes place within 100 milliseconds;
- C. Test the transfer failure scheme and verify that one of the sources opens subsequent to an extended paralleling condition of greater than two (2.0) seconds;
- D. Require immediate notification to Ameren of any periods during testing when the fast transfer equipment is out of service or fails to achieve transfer in 100 milliseconds, or when the transfer failure scheme fails to operate properly; and
- E. Arrange for the appropriate follow-up testing (and notification to Ameren) in the case where any part of the original commissioning procedure couldn't be satisfied.

F. Signature

I hereby certify that, to the best of my knowledge, all the information provided on this Generator Connection Request Form is true and correct. After the installation and testing of the generator and upon proper submission or resubmission of the documentation required by Ameren, I agree to operate the generator in compliance with the conditions stated above.

(1)Customer Signature: _____

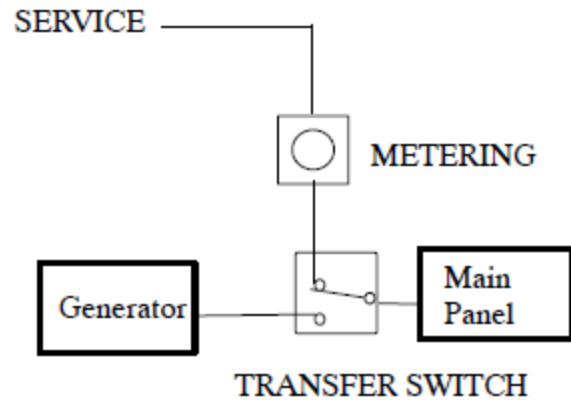
Printed Name: __James Harms _____

Date: _____

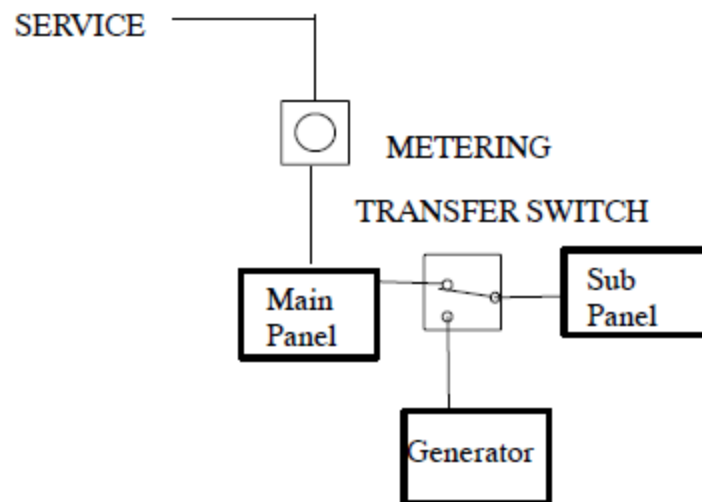
Note: (1) To be signed by the customer, not installation contractor.

MO – PLACEMENT OF CUSTOMER EQUIPMENT

(a) SERVICE ENTRANCE RATED



(b) NON-SERVICE ENTRANCE RATED



Specifications and Requirements
for the
Connection of Electric Generation
that will operate with an
Open Transition (Category 1) between the Ameren System and
the Generator or operate with a
Synchronized Closed Transition (Category 2) between the
Ameren System and the Generator of Less than 100
Milliseconds

Approval shall be obtained from Ameren Corporation for all generation installations.

This document relates to the connection of generation that will synchronize with the Ameren electric system for less than 100 milliseconds. If you are proposing a synchronization time greater than 100 milliseconds, this procedure does not apply. Radial Ameren distribution systems are assumed.

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1. Definitions

- 1.1 **Automatic Transfer** – The switching between an Ameren-provided electrical source and customer-provided generation without the need for human operator intervention.
- 1.2 **Manual (Non-Automatic) Transfer** – The switching between an Ameren-provided electrical supply and customer-provided generation by human operator intervention.
- 1.3 **Open Transition** – The transfer of an electrical load from one power source to another through the use of a double throw switch or interlocks which prevent the closing of the second source before the first source opens.
- 1.4 **Closed Transition** – The transfer of an electrical load from one power source to another by closing the second source before opening the first.
- 1.5 **Parallel Operation** – The closing of the electrical source from customer-provided generation without opening the Ameren-provided electrical source.
- 1.6 **Visible Open Disconnect** – A switching device that enables one to physically see an open air gap that is created by either the disconnect device itself or by its being drawn out from a “seated” or “racked in” position. Molded case circuit breakers, solid state switching devices, static transfer switches and switch status indicators (e.g. lights, operating handle positions, etc.) do not qualify as visible open disconnects.

2. Requirements for all Generation Installations

- 2.1. Transfer equipment shall be designed and installed to prevent inadvertent continuous interconnection and operation of the normal and emergency power sources. This equipment can take many forms depending on the voltage of the associated Ameren service and whether the installation is designed for open or closed transition transfer (ref. Sections 3 and 4 below).
- 2.2. The transfer switch shall be UL listed and the entire transfer equipment installation shall be approved by the proper inspection authorities having jurisdiction and satisfy all applicable building and electrical codes.
 - 2.2.1. If the transfer switch is also being used as the main service disconnect, the transfer switch shall be UL listed specifically for this purpose per the specifications in UL Standard 1008 (Transfer Switch Equipment). UL 1008 specifies that such a transfer switch shall be marked “Suitable [only] for use as service equipment” and shall carry a pressure-sensitive label marked “Service Disconnect.”

- 2.2.2. It is not an Ameren requirement that the transfer equipment be capable of switching or disconnecting the grounded circuit conductor (neutral), though there are circumstances in which Ameren will require that an exception to this be made. Such a determination will be made during Ameren's review of the customer's plan.
- 2.3. Per National Electric Code (NEC) requirements, service entrance conductors and generation supply conductors shall not occupy a common raceway other than in the transfer equipment.
- 2.4. If the Ameren service being backed up by the generator is less than 600V, then the associated main service disconnect device shall be padlockable in the open position for the safety and protection of Ameren personnel.
 - 2.4.1. A sign shall be permanently installed at the associated revenue metering location that states, "Backup Generation Present – Lockable Main Service Disconnect Available for Isolation." The sign shall have minimum dimensions of 5"x 7", be permanently secured with bolts, and shall be both waterproof and ultraviolet resistant.
 - 2.4.2. A sign shall also be permanently installed at the main service disconnect device itself stating, "Lockable Main Service Disconnect for Isolation from Generator" for purposes of identification by Ameren field personnel. It shall be similar in size, make and color to the sign at the revenue meter so that an association can be easily made. All other NEC and building code requirements around electric facility-related signage shall be followed.
 - 2.4.3. *For pre-existing main service disconnects only:* If the Ameren service being backed up is a self-contained metered service (i.e. no metering CT's) and the pre-existing main service disconnect is unable to be padlocked in the open position, the self-contained meter, being a "visible open disconnect" device (ref. Section 1.6) shall satisfy this requirement.
- 2.5. If the Ameren service being backed up by the generator is greater than 600V, then at least one "visible open disconnect" device (ref. Section 1.6) shall be required for the safety and protection of Ameren personnel.
 - 2.5.1. Each visible open disconnect device shall isolate one or more of the customer's generating units from the rest of the system. All generating units shall be associated with at least one of these devices.
 - 2.5.2. The visible open disconnect device shall be accessible to Ameren personnel at all times. While the device does not have to be under Ameren's exclusive control, it shall have provisions for being padlocked

in the open position or in the “drawn out” position by Ameren personnel should the need for temporary electrical isolation present itself.

- 2.5.3. A sign shall be permanently installed at the associated revenue metering location that states, “Backup Generation Present – Lockable Visible Open Disconnect Available for Isolation.” The sign shall have minimum dimensions of 5”x 7”, be permanently secured with bolts, and shall be both waterproof and ultraviolet resistant.
- 2.5.4. A sign shall also be permanently installed at the visible open disconnect device itself stating, “Lockable Visible Open Disconnect for Isolation from Generator” for purposes of identification by Ameren field personnel. It shall be similar in size, make and color to the sign at the revenue meter so that an association can be easily made. All other NEC and building code requirements around electric facility-related signage shall be followed.

3. Requirements Specific to Open Transition Transfer (Category 1)

- 3.1. An open transition between the Ameren system and customer generator(s) can be achieved with any of the following:
 - 3.1.1. An integral transfer switch with mechanical interlocking provisions (e.g. a double throw configuration, mechanical locking bar, etc.) to prevent the closing of both sources at the same time;
 - 3.1.2. A pair of Kirk key-interlocked disconnect switches or circuit breakers; or
 - 3.1.3. A pair of circuit breakers with electrical interlocking provisions to prevent the closing of both sources at the same time, provided that the interlocking scheme is backed up with hard-wired protection directly from the breaker auxiliary contacts.
- 3.2. If the open transition between the Ameren system and customer generator(s) is being achieved via automatic transfer means, then the following shall apply:
 - 3.2.1. Voltage-sensing capability or other means for detecting the loss and recovery of the Ameren source shall be required.
 - 3.2.2. A manual “bypass” (i.e. auto disable) feature is not required, but it is highly recommended for use in the event of a malfunction in the automatic transfer between sources in either direction. If this provision exists, it shall be open transition in nature and mechanically interlocked (e.g. a double throw configuration, mechanical locking bar, etc.) to

prevent the closing of both sources at the same time. If the bypass switch is separate from the transfer switch, it shall also be mechanically interlocked against its being switched to one source while the transfer switch is switched to the other.

- 3.2.3. The automatic transfer controller shall be “supervised” by the status of the transfer switch (and that of the bypass switch if it exists) so that if either switch is manually tripped, automatic control will be disabled.

4. Requirements Specific to Closed Transition Transfer (Category 2)

- 4.1. A closed transition between the Ameren system and customer generator(s) can be achieved either with an integral automatic transfer switch set or with two or more circuit breakers or motor-operated solid blade disconnects.
- 4.2. Synchronizing capability shall be required in order for the Ameren-provided source and the customer-provided generation to be safely tied together. All synchronized transfer times shall be held to less than 100 milliseconds in duration.
- 4.3. A transfer failure scheme shall be required that activates when the period of synchronized closed transition exceeds a set time delay that is no longer than two (2.0) seconds.
- 4.3.1. Upon activation, the transfer failure scheme will open one of the two sources being paralleled and lock out the control circuit from any further transfer operation.
- 4.3.2. For cases with a maximum time delay relay range greater than two (2.0) seconds, Ameren will also require Device 32 (directional power) and Device 67 (directional overcurrent) relays. These relays shall be of a draw-out type with built-in test devices. Otherwise, external test devices (such as the ABB FT-1) are required for the isolation of trip contacts and PT/CT inputs as well as the injection of secondary voltages and currents during testing.
- 4.3.3. If the transfer switch has the capability of providing a hard-wired signal that could trip a device that is separate from the transfer switch equipment in order to interrupt a paralleling event exceeding 100 milliseconds, the customer shall see to it that this feature is utilized. The control scheme shall trip the device and then block it from closing. The time delay on the trip signal shall not exceed two (2.0) seconds.
- 4.3.4. If the Ameren service being backed up by the generator is greater than 600V, an additional independent hard-wired breaker auxiliary contact

scheme may be required to break up extended paralleling of the two sources. Ameren prefers this type of backup scheme and will only accept another scheme pending a detailed evaluation.

- 4.3.5. There shall be no intended or built-in provision for the customer to disable the transfer failure scheme.
- 4.4. An undervoltage protection provision shall be required which prevents a closed transition transfer in the event that the Ameren source is not present.
- 4.5. In the event of a malfunction in the automatic transfer between sources in either direction, the transfer switch shall be able to be manually switched to the desired source.
- 4.6. A manual “bypass” (i.e. auto disable) feature is not required, but it is highly recommended for use in the event of a malfunction in the automatic transfer between sources in either direction. If this provision exists, it shall be open transition in nature and mechanically interlocked (e.g. a double throw configuration, mechanical locking bar, etc.) to prevent the closing of both sources at the same time. If the bypass switch is separate from the transfer switch, it shall also be mechanically interlocked against its being switched to one source while the transfer switch is switched to the other.
- 4.7. The automatic transfer controller shall be “supervised” by the status of the transfer switch (and that of the bypass switch if it exists) so that if either switch is manually tripped, automatic control will be disabled.

5. Programmable Logic Controllers (PLC)

- 5.1. For purposes of establishing the requirements herein, Ameren defines a programmable logic controller (PLC) as any solid-state microprocessor-based controller that needs to be programmed by the user with the logic necessary for it to supervise and execute the control functions for which it is being utilized. This is separate from a factory-programmed controller whose logic restricts the system to a single “proprietary” mode of operation, the parameters of which need merely to be configured by the user. It is understood that the PLC can exist as a stand-alone unit or as a permanent component of an integral automatic transfer switch.
- 5.2. Ameren will allow the use of PLCs for automatic transfer control between an Ameren-provided supply and customer-provided generation with the following requirements:
 - 5.2.1. A backup control scheme shall be provided to prevent the extended paralleling operation of the generator with the Ameren system. The

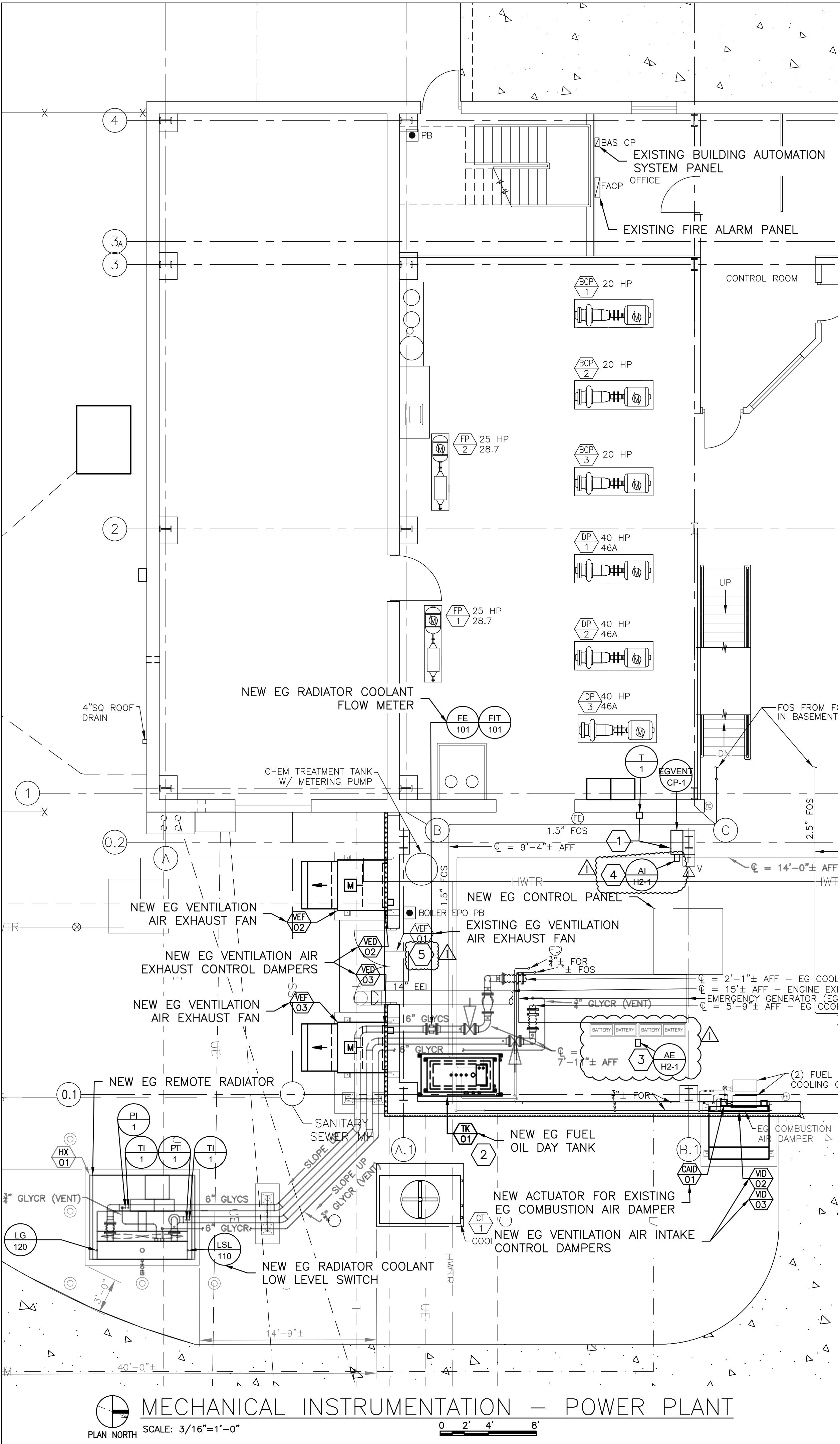
backup control shall be completely independent of the PLC. Software contacts or backup logic are not acceptable.

- 5.2.2. The backup control shall trip open a device that is separate from the transfer equipment and block it from closing in the event of extended parallel operation with the Ameren system.
 - 5.2.3. The PLC and backup control logic shall be enabled when the transfer scheme is placed in automatic operation and disabled when the transfer scheme is placed in manual operation.
 - 5.2.4. The automatic transfer switch shall be “supervised” by the status of the disconnect switch, circuit breaker or bypass switch controls so that if any of these switches is manually tripped, the PLC control will disable automatic transfer.
 - 5.2.5. The PLC shall not lose power at any time as a direct result of automatic transfer switching operations. This shall be confirmed during Ameren’s functional test of the automatic transfer equipment.
- 5.3. There are two preferred methods of PLC backup control:
- 5.3.1. The first method is through the use of the hard-wired auxiliary contacts of the associated breakers. The time delay shall be minimal and typically no longer than two (2.0) seconds in duration. The time delay range and setting shall be reviewed by Ameren.
 - 5.3.2. For those cases where the maximum time delay range exceeds two (2.0) seconds, Ameren will also require Device 32 (directional power) and Device 67 (directional overcurrent) relays. These relays shall be of a draw-out type with built-in test devices. Otherwise, external test devices (such as the ABB FT-1) are required for the isolation of trip contacts and PT/CT inputs as well as the injection of secondary voltages and currents during testing. The maximum time delay shall be absolutely no longer than thirty (30) seconds in duration.
 - 5.3.3. A second method for PLC backup control (provided a hard-wired auxiliary contact scheme is not possible) is to install Device 32 (directional power), Device 67 (directional overcurrent) and Device 59N (neutral overvoltage) relays that are approved by Ameren. The operation of all these relays shall trip and lock out the generator breaker or another disconnecting device that isolates the customer generator from the Ameren source. The Device 59N requires the installation of grounded wye to open delta potential devices on the delta high side of the distribution or substation transformer supplying the customer.

6. Drawing Requirements for Generator Installations

- 6.1. For generator installations utilizing integral transfer switches enclosed in a single compartment, the following documentation is required in triplicate:
 - 6.1.1. A one-line diagram is required showing the electrical location of the Ameren source as well as that of the generator, the transfer switch, and if applicable, the visible open disconnect device inside the customer facility.
 - 6.1.2. Details on the signage at both the revenue meter and the lockable main service disconnect or visible open disconnect, including size, wording and physical location, shall be required.
 - 6.1.3. A manufacturer's cut sheet, operations manual and other specifications are required for the particular transfer switch being installed. Among the more critical information therein are the manufacturer's model number, transfer scheme type (open or closed transition), locking provisions, interlock details, and if applicable, the time range of closed transition, and details on the auto/manual and manual bypass switches.
 - 6.1.4. Drawings on both the closed transition transfer and transfer failure schemes are required, which include the time delay setting and maximum range.
- 6.2. For generator installations utilizing circuit breakers or disconnect switches mounted in separate compartments, the following documentation is required in triplicate:
 - 6.2.1. A one-line diagram is required showing the electrical location of the Ameren source as well as that of the generator and associated transfer switch in the customer facility.
 - 6.2.2. Details on the signage at both the revenue meter and the lockable main service disconnect or visible open disconnect, including size, wording and physical location, shall be required.
 - 6.2.3. Detailed control schematics of the main breaker and generator breaker trip and close control circuits are required. These schematics shall show all protective relay functions and provide the information necessary to analyze and document the logic associated with the generator transfer scheme, transfer failure scheme, interlock controls and any other pertinent control functions.

- 6.2.4. Drawings on both the closed transition transfer and transfer failure schemes are required, which include the time delay setting and maximum range.



NEW EG ROOM VENTILATION SYSTEM
SEQUENCE OF OPERATION:

1. NEW CONTROL PANEL, EGVENT-CP-1, SHALL CONTROL NEW EG ROOM VENTILATION SYSTEMS.
2. MONITOR AND DISPLAY EG ROOM TEMPERATURE, T-1.
 - 2.1. ALARM WHEN ROOM TEMPERATURE IS BELOW 45 F AND ABOVE 120 F.
3. VENTILATION INTAKE AND EXHAUST DAMPERS SHALL HAVE FAIL-CLOSED, POWER TO OPEN, MODULATING ACTUATORS WITH AN ANALOG POSITION FEEDBACK SIGNAL AND DIGITAL FULLY OPEN AND FULLY CLOSED POSITION FEEDBACK SIGNALS.
4. CONTROL PANEL SHALL INCLUDE A HAND-OFF-AUTO SELECTOR SWITCH FOR NEW VENTILATION SYSTEM.
5. IN AUTO MODE, VENTILATION SYSTEM SHALL BE INTERLOCKED WITH THE NEW EG CONTROL PANEL.
 - 5.1. VENTILATION SYSTEM SHALL START WHEN EG IS ENERGIZED.
 - 5.2. VENTILATION SYSTEM SHALL STOP WHEN EG IS DE-ENERGIZED WITH OPERATOR ADJUSTABLE TIME DELAY (0 TO 180 MINUTES).
 - 5.3. MODULATE VENTILATION INTAKE DAMPER, VID-02, & VENTILATION EXHAUST DAMPER, VED-02, TO CONTROL ROOM TEMPERATURE TO SET POINT, 60 F (ADJUSTABLE).
 - 5.4. MODULATE VENTILATION INTAKE DAMPER, VID-03, & VENTILATION EXHAUST DAMPER, VED-03, TO CONTROL ROOM TEMPERATURE TO SET POINT, 70 F (ADJUSTABLE).
 - 5.5. IF DAMPERS ARE 100% OPEN AND ROOM TEMPERATURE IS ABOVE SET POINT, 80 F (ADJUSTABLE), START VENTILATION EXHAUST FAN VEF-02.
 - 5.5.1. MODULATE FAN SPEED TO CONTROL ROOM TEMPERATURE TO SET POINT, 80 F (ADJUSTABLE)
 - 5.5.2. SHUTDOWN FAN WHEN ROOM TEMPERATURE IS 5 F (ADJUSTABLE) BELOW SET POINT.
 - 5.5.3. FAN SHALL RUN A MINIMUM OF 10 MINUTES (ADJUSTABLE) TO AVOID SHORT CYCLING.
 - 5.5.4. INTERLOCK VEF-02 START WITH VID-02 & VED-02 100% OPEN POSITION SWITCHES.
 - 5.6. IF VEF-02 IS AT FULL SPEED AND ROOM TEMPERATURE IS ABOVE SET POINT, 90 F (ADJUSTABLE), START VENTILATION EXHAUST FAN, VEF-03.
 - 5.6.1. MODULATE FAN SPEED TO CONTROL ROOM TEMPERATURE TO SET POINT, 90 F (ADJUSTABLE).
 - 5.6.2. SHUTDOWN FAN WHEN ROOM TEMPERATURE IS 5 F (ADJUSTABLE) BELOW SET POINT.
 - 5.5.3. FAN SHALL RUN A MINIMUM OF 10 MINUTES (ADJUSTABLE) TO AVOID SHORT CYCLING.
 - 5.5.4. INTERLOCK VEF-03 START WITH VID-03 & VED-03 100% OPEN POSITION SWITCHES.
6. VENTILATION FANS ARE SIZED TO MAINTAIN A 20 F TEMPERATURE RISE ABOVE AMBIENT TEMPERATURES WHEN THE GENERATOR IS OPERATING AT FULL LOAD.
 - 6.0.1. ROOM TEMPERATURE WILL EXCEED SET POINTS WHEN AMBIENT TEMPERATURES ARE HIGH.
7. IN HAND MODE, OPERATOR SHALL BE ABLE TO ADJUST DAMPER POSITIONS, START AND STOP FANS, AND ADJUST FAN SPEEDS AT CONTROL PANEL INTERFACE.
- 7.6. INTERLOCK VEF-02 START WITH VID-02 & VED-02 100% OPEN POSITION SWITCHES.
- 7.7. INTERLOCK VEF-03 START WITH VID-03 & VED-03 100% OPEN POSITION SWITCHES.
8. INTERLOCK EG VENTILATION SYSTEM WITH POWER PLANT FIRE ALARM CONTROL PANEL.
 - 8.1. WHEN EG IS NOT ENERGIZED, UPON ACTIVATION OF FIRE ALARM PANEL, SHUTDOWN VENTILATION FANS & CLOSE VENTILATION DAMPERS.
 - 8.2. VENTILATION SYSTEM SHALL REMAIN IN OPERATION WHEN EG IS ENERGIZED.
9. DISPLAY ALL CONTROL SYSTEM INPUT AND OUTPUT SIGNALS AT PANEL OPERATOR INTERFACE.

EG COMBUSTION AIR SYSTEM SEQUENCE
OF OPERATION:

1. EXISTING EG COMBUSTION AIR INTAKE DAMPER, CAID-01, SHALL REMAIN IN PLACE.
2. INSTALL NEW ACTUATOR ON EXISTING DAMPER.
3. CAID-01 DAMPER SHALL BE FAIL OPEN & POWER TO CLOSE WITH TWO-POSITION ACTUATOR, WITH DIGITAL FULLY OPEN AND FULLY CLOSED POSITION FEEDBACK SIGNALS.
4. CAID-01 SHALL BE INTERLOCKED WITH THE NEW EG CONTROL PANEL
 - 4.1. DAMPER SHALL OPEN 100% WHEN EG IS ENERGIZED.
 - 4.2. DAMPER SHALL CLOSE 100% WHEN EG IS DE-ENERGIZED WITH OPERATOR ADJUSTABLE TIME DELAY (0 TO 60 MINUTES).
 - 4.3. THIS INTERLOCK SHALL BE HARD-WIRED FROM THE EG CONTROL SYSTEM WITH RELAYS & SHALL BE INDEPENDENT OF ANY DDC FUNCTIONS.
5. DAMPER OPEN & CLOSED POSITION SWITCH SIGNALS SHALL BE INDICATED ON NEW EG CONTROL PANEL FACE.
 - 5.1. ALARM WHEN EG IS RUNNING AND DAMPER IS CLOSED.
 - 5.2. ALARM WHEN EG IS NOT RUNNING AND DAMPER IS OPEN AFTER PROGRAMMED TIME DELAY.

EXISTING EG VENTILATION AIR SYSTEM
SEQUENCE OF OPERATION:

1. EXISTING EG VENTILATION EXHAUST FAN, VEF-01, SHALL REMAIN IN PLACE.
2. EXISTING FAN BACK-DRAFT EXHAUST DAMPER SHALL REMAIN IN PLACE.
3. EXISTING FAN HAND-OFF-AUTO SWITCH SHALL REMAIN IN PLACE.
4. IN HAND MODE, FAN SHALL RUN.
5. IN AUTO MODE, VEF-01 SHALL BE INTERLOCKED WITH THE NEW EG CONTROL PANEL & HYDROGEN GAS DETECTOR.
 - 5.1. FAN SHALL START WHEN EG IS ENERGIZED.
 - 5.2. FAN SHALL STOP WHEN EG IS DE-ENERGIZED WITH OPERATOR ADJUSTABLE TIME DELAY (0 TO 180 MINUTES).
 - 5.3. THIS INTERLOCK SHALL BE HARD-WIRED FROM THE EG CONTROL SYSTEM WITH RELAYS & SHALL BE INDEPENDENT OF ANY DDC FUNCTIONS.
 - 5.4. FAN SHALL START WHEN HYDROGEN LEVELS REACH 1% BY VOLUME.
 - 5.5. FAN SHALL STOP WHEN HYDROGEN LEVELS REDUCE TO LESS THAN 1% BY VOLUME WITH OPERATOR ADJUSTABLE TIME DELAY (10 TO 60 MINUTES).
6. INTERLOCK EXISTING EG VENTILATION SYSTEM WITH EXISTING POWER PLANT FIRE ALARM CONTROL PANEL.
 - 6.1. WHEN EG IS NOT ENERGIZED, UPON ACTIVATION OF FIRE ALARM PANEL, SHUTDOWN VENTILATION FAN.
 - 6.2. VENTILATION FAN SHALL REMAIN IN OPERATION WHEN EG IS ENERGIZED.
7. MONITOR AND DISPLAY FAN AND HYDROGEN GAS DETECTOR STATUS.
 - 7.1. INDICATE ROOM HYDROGEN LEVELS.
 - 7.2. ALARM WHEN ROOM HYDROGEN LEVELS EXCEED 1% BY VOLUME.
 - 7.3. ALARM WHEN ROOM HYDROGEN LEVELS EXCEED 2% BY VOLUME.
 - 7.4. ALARM ON GAS DETECTION SYSTEM FAULT..
 - 7.5. ALARM WHEN FAN IS COMMANDED ON AND FAILS TO RUN.

NEW EG COOLANT SYSTEM SEQUENCE OF
OPERATION:

1. NEW EG COOLANT SYSTEM SHALL INCLUDE A REMOTE RADIATOR, HX-1, HAND-AUTO SWITCH, LOW LEVEL SWITCH, AND FLOW METER.
2. IN HAND MODE, REMOTE RADIATOR FAN SHALL RUN.
3. IN AUTO MODE, REMOTE RADIATOR FAN SHALL BE INTERLOCKED WITH THE NEW EG CONTROL PANEL.
 - 3.1. RADIATOR FAN SHALL START WHEN EG IS ENERGIZED.
 - 3.2. FAN SHALL STOP WHEN EG IS DE-ENERGIZED WITH OPERATOR ADJUSTABLE TIME DELAY (0 TO 60 MINUTES).
 - 3.3. THIS INTERLOCK SHALL BE HARD-WIRED FROM THE EG CONTROL SYSTEM WITH RELAYS & SHALL BE INDEPENDENT OF ANY DDC FUNCTIONS.
4. NEW EG CONTROL PANEL SHALL MONITOR AND DISPLAY EG RADIATOR COOLANT LEVEL SWITCH STATUS, LSL-110.
5. NEW EG CONTROL PANEL SHALL MONITOR AND DISPLAY EG RADIATOR COOLANT FLOW METER SIGNAL, FE-101 / FIT-101.

NEW EG FUEL OIL DAY TANK SYSTEM
SEQUENCE OF OPERATION:

1. NEW EG FUEL OIL DAY TANK SYSTEM SHALL INCLUDE THE MANUFACTURER'S FACTORY-PACKAGED INSTRUMENTATION & CONTROL SYSTEM.
2. THE POWER PLANT'S EXISTING BUILDING AUTOMATION SYSTEM (BAS) SHALL MONITORING AND DISPLAY DAY TANK CONTROL SYSTEM STATUS.

GENERAL NOTES:

- A. FIELD VERIFY EXISTING CONDITIONS PRIOR TO PROCEEDING.

KEY NOTES:

1. REVIEW LOCATION WITH OWNER'S REPRESENTATIVE PRIOR TO PROCEEDING.
2. SEE M-610 FOR NEW FUEL OIL DAY TANK CONTROL SYSTEM.
3. HYDROGEN GAS DETECTOR.
 - 3.1. INSTALL WITHIN 12" OF CEILING ABOVE BATTERIES.
4. HYDROGEN GAS DETECTOR REMOTE REPEATER PANEL.
 - 4.1. INSTALL NEAR EYE LEVEL IN ACCESSIBLE LOCATION.
5. INSTALL CURRENT SWITCH TO MONITOR EXISTING FAN.

SOLE SOURCE HVAC I&C SUBCONTRACTOR:

1. THE HVAC INSTRUMENTATION AND CONTROLS SUBCONTRACTOR FOR THIS PROJECT SHALL BE C&C GROUP. CONTACT: COREY SCHEPERS, C&C GROUP, CSCHEPERS@C-CGROUP.COM, (913) 530-7369.



CHRISTOPHER L. BARTH
Registered Professional Engineer
MO # E-28880
Expires 12-31-2025

ROGERS-SCHMIDT
ENGINEERING CO., P.C.
CONSULTING ENGINEERS
1736 WEST PARK CENTER DR.
SUITE 204
ST. LOUIS, MO 63026
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MISSOURI STATE CERTIFICATE
OF AUTHORITY #000408

OFFICE OF ADMINISTRATION
DIVISION OF FACILITIES
MANAGEMENT,
DESIGN AND CONSTRUCTION

DEPARTMENT OF
CORRECTIONS

UPGRADE GENERATOR
CONTROLS & TRANSFER
SWITCH, POWER PLANT

MOBERLY CORRECTIONAL
CENTER
5201 SOUTH MORLEY ST.
MOBERLY, MO 65270

PROJECT # C1920-01
SITE # 7005
ASSET # 9327005051

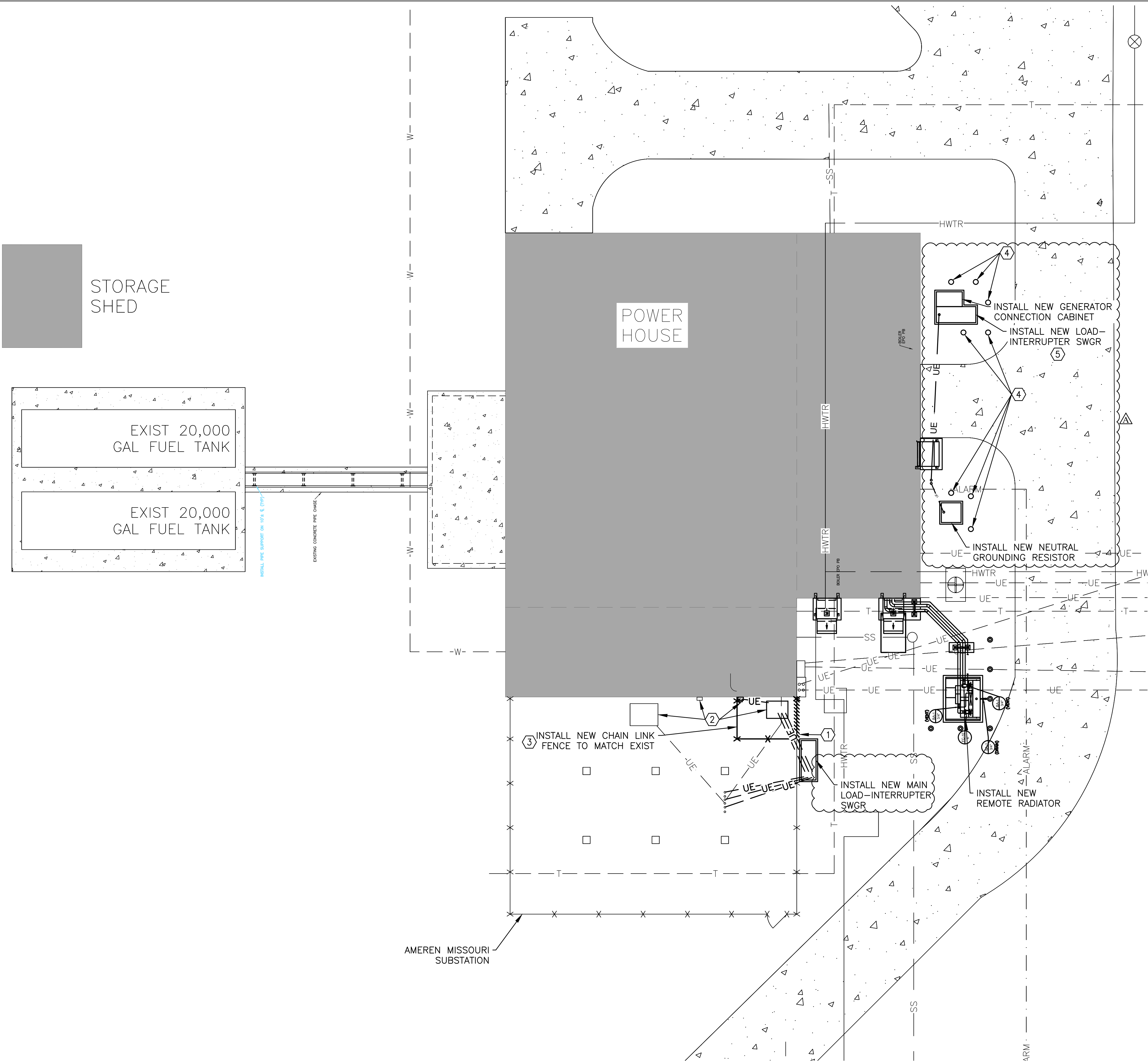
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DATE: _____
REVISION: _____
DATE: _____
REVISION: ADDENDUM #2
DATE: 11/07/2025
ISSUE DATE: 09/22/2025

CAD DWG FILE: C1920-01-7005-
9327005051-MI-SERIES.DWG
DRAWN BY: C L B
CHECKED BY: C L B
DESIGNED BY: C L B

SHEET TITLE:
MECHANICAL -
INSTRUMENTATION
& CONTROLS -
POWER PLANT

SHEET NUMBER:

MI-401
14 OF 28 SHEETS
SEPTEMBER 22, 2025



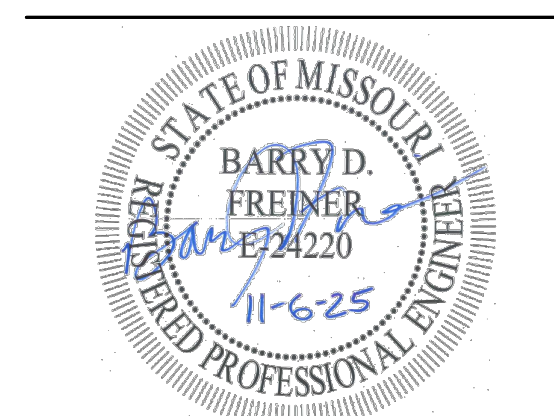
GENERAL NOTE:

A. FIELD VERIFY EXISTING CONDITIONS PRIOR TO PROCEEDING.

KEY NOTES:

1. REMOVE EXIST CHAIN LINK FENCE.
2. RELOCATE EXIST METERING SWGR & AMEREN METER. SEE DWGS ED-401 & E-401.
3. SEE DWGS E-401 & E-501.
4. PROVIDE PROTECTIVE PIPE BOLLARDS PER DETAIL ON DWG M-501. COORDINATE WITH OWNER'S REPRESENTATIVE FOR FINAL BOLLARD LOCATIONS.
5. ALTERNATE BID NO. 1

STATE OF MISSOURI
MIKE KEHOE,
GOVERNOR



BARRY D. FREINER
Registered Professional Engineer
MO # E-24220
Expires 12-31-2026

ROGERS-SCHMIDT
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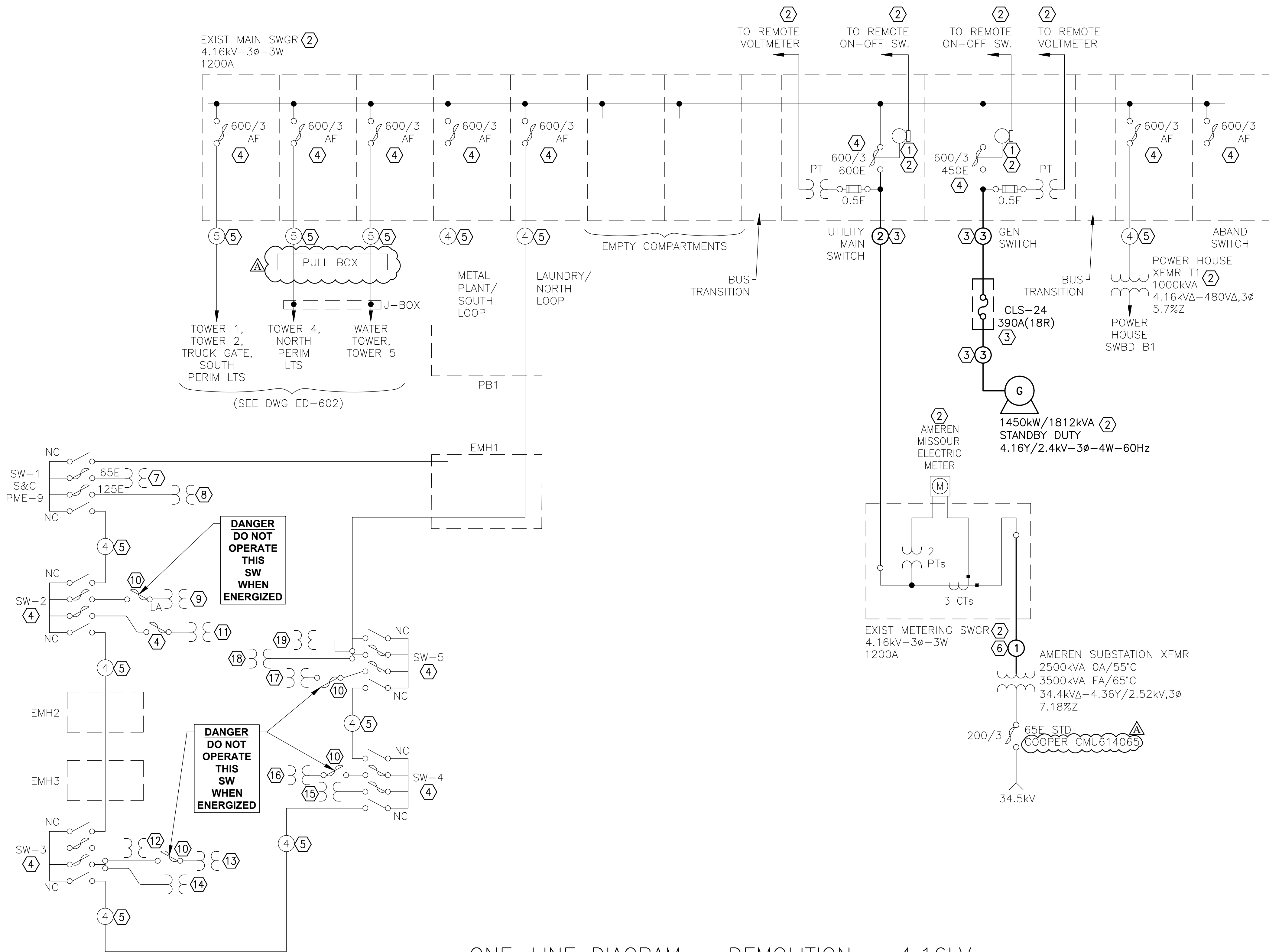
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DRAWN BY: K E T
CHECKED BY: B D F
DESIGNED BY: B D F

SHEET TITLE:
ELECTRICAL SITE
PLAN

SHEET NUMBER:

ES-101

16 OF 28 SHEETS
SEPTEMBER 22, 2025



ONE-LINE DIAGRAM – DEMOLITION – 4.16kV

MEDIUM-VOLTAGE FEEDER SCHEDULE - EXISTING									
FEEDER NUMBER	CIRCUIT VOLTAGE	PHASE CONDUCTORS			NEUTRAL CONDUCTORS		GROUNDING CONDUCTORS		RACEWAY
		PHASE	QTY PER PHASE	SIZE	QTY	SIZE	QTY	SIZE	
5	1	4.16kV	3	3	500KCM	-	-	-	(3) 5"
5	2	4.16kV	3	3	500KCM	-	-	-	(3) 4"
	3	4.16kV	3	1	250KCM	1	250KCM	-	4"
5	4	4.16kV	3	1	500KCM	-	-	1	4"
5	5	4.16kV	3	1	1/0	-	-	1	2"

GENERAL NOTE:

A. FIELD VERIFY EXISTING CONDITIONS PRIOR TO PROCEEDING.

KEY NOTES:

- MOTOR OPERATOR.
- EXIST ITEM(S) TO REMAIN.
- EXIST ITEM(S) TO BE REMOVED.
- UNVERIFIABLE WHILE SWGR IS ENERGIZED. FIELD VERIFY AND DOCUMENT EXIST FUSE SIZE & TYPE DURING SCHEDULED POWER OUTAGE.
- UNVERIFIABLE WHILE SWGR IS ENERGIZED. FIELD VERIFY AND DOCUMENT EXIST CONDUIT SIZE & TYPE AND CABLE TYPE, QTY & SIZES, INCL GRD DURING SCHEDULED POWER OUTAGE.
- REMOVE CABLES FROM EXIST CONDUITS. CONDUITS TO REMAIN.
- EXIST 300kVA, 4.16kVΔ-208Y/120V, 3-PHASE DRY TYPE XFMR, 6.6%Z AT METAL PLANT.
- EXIST 500kVA, 4.16kVΔ-480Y/277V, 3-PHASE DRY TYPE XFMR, 5.6%Z AT METAL PLANT.
- EXIST 225kVA, 4.16kVΔ-208Y/120V, 3-PHASE DRY TYPE XFMR, 4.7%Z AT HU 1.
- EXIST G&W 4.16kV, 3-PHASE OIL INS SWITCH.
- EXIST 500kVA, 4.16kVΔ-208Y/120V, 3-PHASE DRY TYPE XFMR, 5.94%Z AT FOOD SERVICE.
- EXIST 300kVA, 4.16kVΔ-208Y/120V, 3-PHASE DRY TYPE XFMR, 5.6%Z AT HU 3.
- EXIST 500kVA, 4.16kVΔ-208Y/120V, 3-PHASE DRY TYPE XFMR, 5.8%Z AT ADMIN BLDG.
- EXIST 300kVA, 4.16kVΔ-480Y/277V, 3-PHASE DRY TYPE XFMR, 4.2%Z AT ADMIN BLDG FOR CHILLERS.
- EXIST 300kVA, 4.16kVΔ-208Y/120V, 3-PHASE DRY TYPE XFMR, 4.99%Z AT SCHOOL.
- EXIST 225kVA, 4.16kVΔ-208Y/120V, 3-PHASE DRY TYPE XFMR, 4.7%Z AT HU 2.
- EXIST 225kVA, 4.16kVΔ-208Y/120V, 3-PHASE DRY TYPE XFMR, 4.7%Z AT SIGN SHOP.
- EXIST 225kVA, 4.16kVΔ-208Y/120V, 3-PHASE DRY TYPE XFMR AT PRINT SHOP/LAUNDRY (NO NAMEPLATE ON XFMR).
- EXIST 300kVA, 4.16kVΔ-480Y/277V, 3-PHASE DRY TYPE XFMR, 3.87%Z AT MVE WAREHOUSE.

STATE OF MISSOURI
MIKE KEHOE,
GOVERNOR



BARRY D. FREINER
Registered Professional Engineer
MO # E-24220
Expires 12-31-2026

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OFFICE OF ADMINISTRATION
DIVISION OF FACILITIES
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DEPARTMENT OF
CORRECTIONS

UPGRADE GENERATOR
CONTROLS & TRANSFER
SWITCH, POWER PLANT

MOBERLY CORRECTIONAL
CENTER
5201 SOUTH MORLEY ST.
MOBERLY, MO 65270

PROJECT # C1920-01
SITE # 7005
ASSET # 9327005051

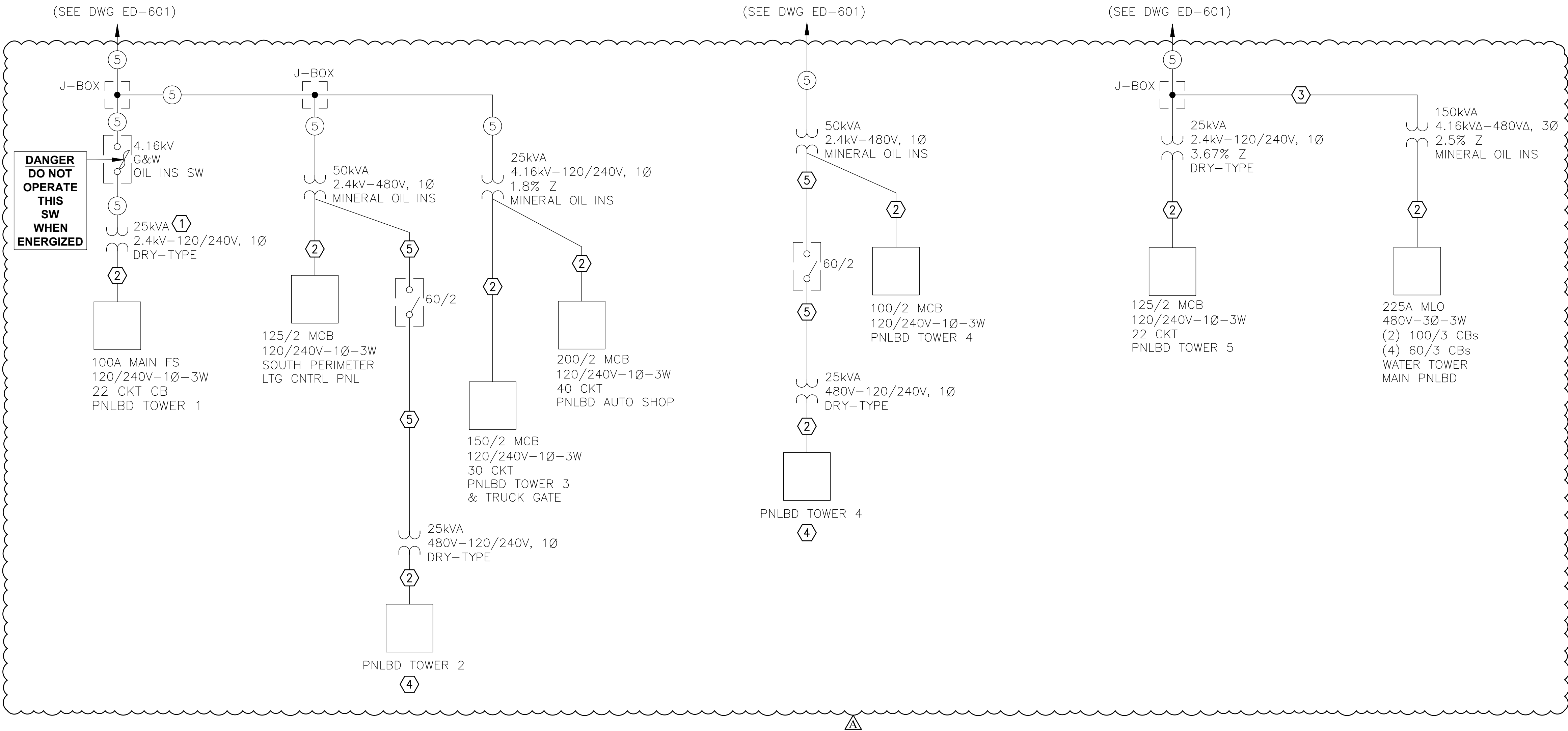
REVISION: _____
DATE: _____
REVISION: _____
DATE: _____
REVISION: **ADDENDUM 2**
DATE: 11/07/2025
ISSUE DATE: 09/22/2025

CAD DWG FILE: C1920-01-7005-
9327005051-ED-601.DWG
DRAWN BY: KET/MNS
CHECKED BY: BDF
DESIGNED BY: BDF

SHEET TITLE:
ONE-LINE
DIAGRAM -
DEMOLITION -
4.16kV

SHEET NUMBER:

ED-601



ONE-LINE DIAGRAM-EXISTING CONDITION

GENERAL NOTE:

- A. FIELD VERIFY EXISTING CONDITIONS PRIOR TO PROCEEDING.
- B. SEE MV FDR SCHED ON DWG ED-601.
- C. THE PURPOSE OF THIS DWG IS TO PROVIDE INFORMATION FOR THE SPECIFICATION SECTION 260573 ARC FLASH RISK ASSESSMENT.

KEY NOTES:

- NO EXTERNAL NP ON XFMR. REMOVE FRONT COVER FROM XFMR ENCL & UPDATE INFORMATION INCL %Z, FROM INTERIOR EQUIP NP.
- FIELD VERIFY AND RECORD EXIST FDR CONDUCTOR SIZE.
- FIELD VERIFY AND RECORD EXIST 4.16kV CABLE SIZE.
- FIELD VERIFY AND RECORD 120/240V-1Ø-3W PNLBD MCB SIZE & NUMBER OF CKT POSITIONS.
- 2#6

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PROJECT # C1920-01
SITE # 7005
ASSET # 9327005051

REVISION: _____
DATE: _____
REVISION: _____
DATE: _____
REVISION: **ADDENDUM 2**
DATE: 11/07/2025

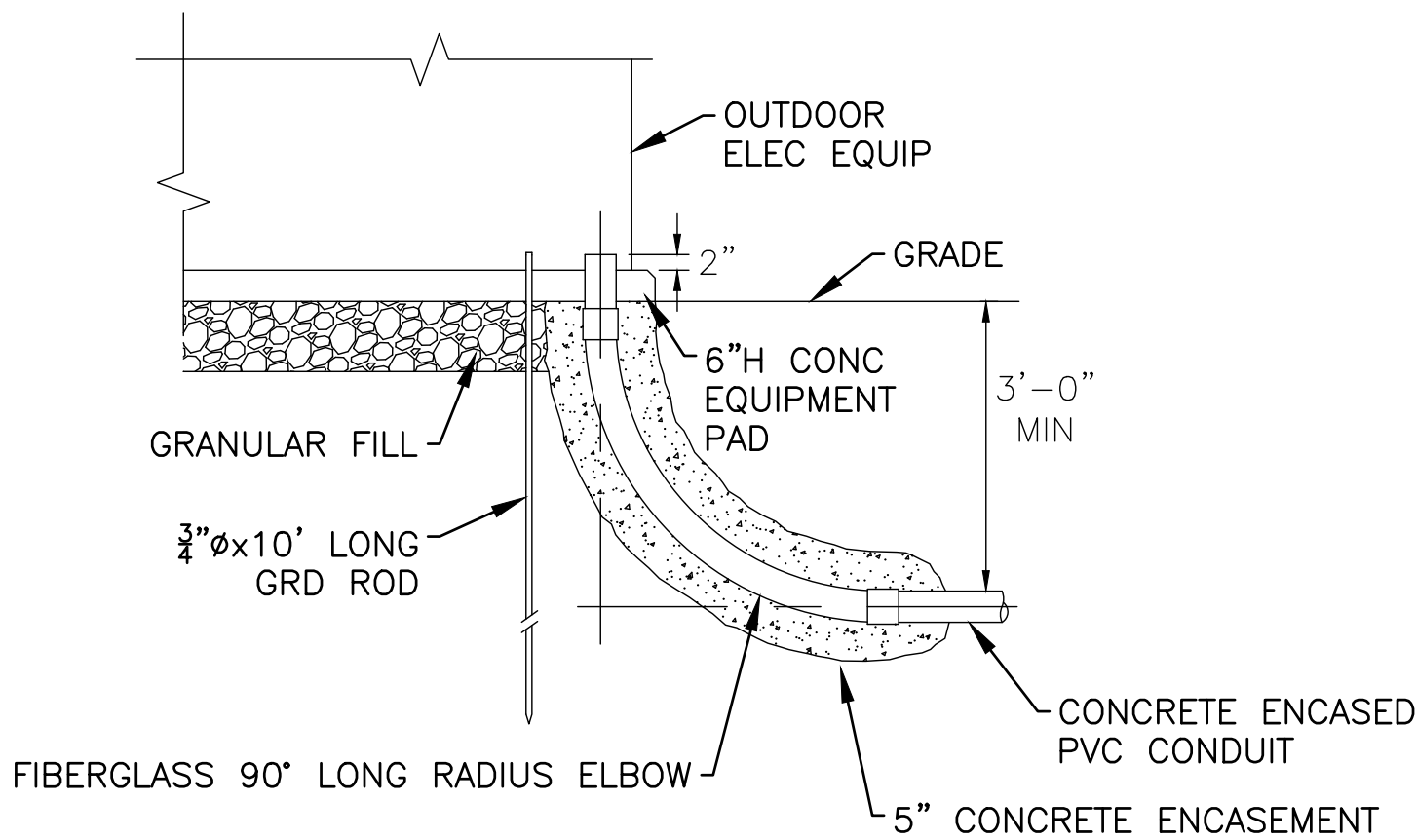
ISSUE DATE: 09/22/2025

CAD DWG FILE: C1920-01-7005-
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DRAWN BY: KET
CHECKED BY: BDF
DESIGNED BY: BDF

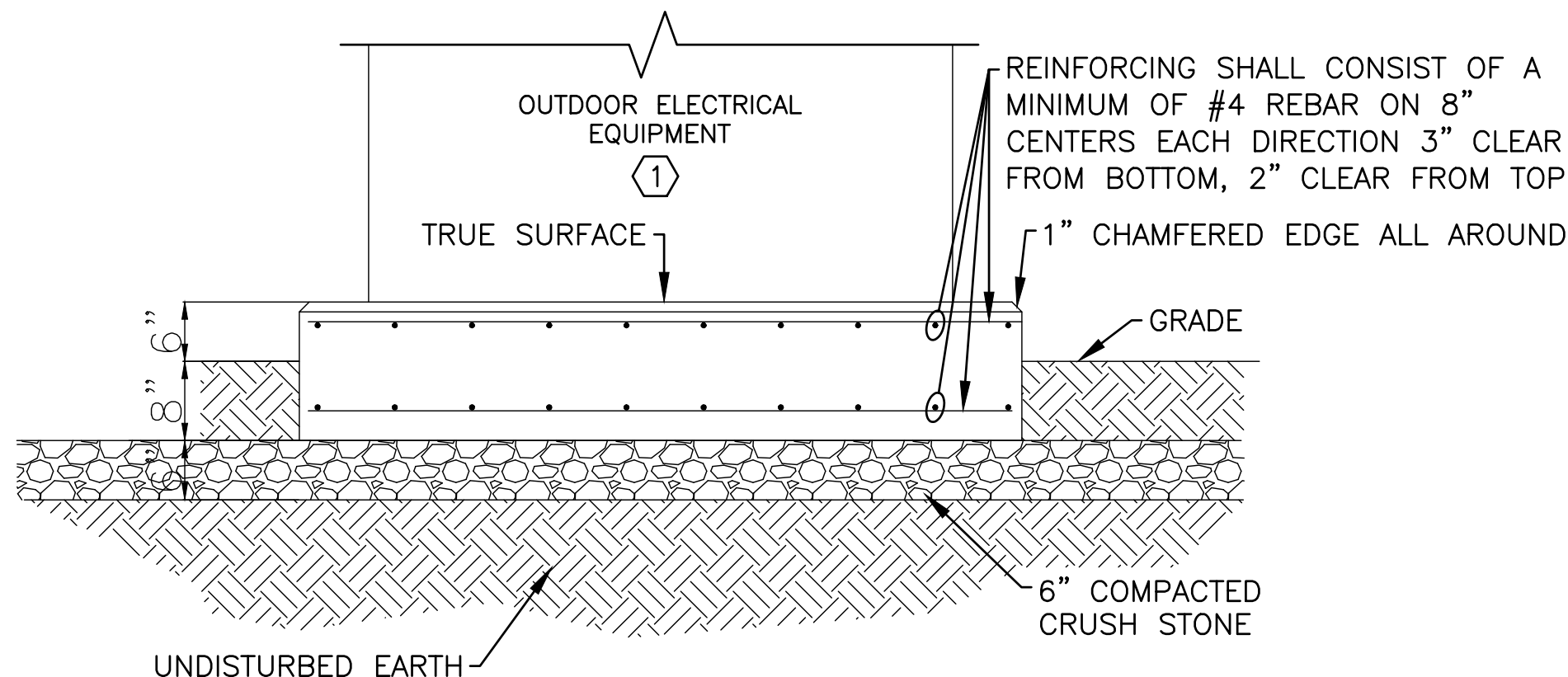
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ONE-LINE
DIAGRAM -
EXISTING
CONDITION

SHEET NUMBER:

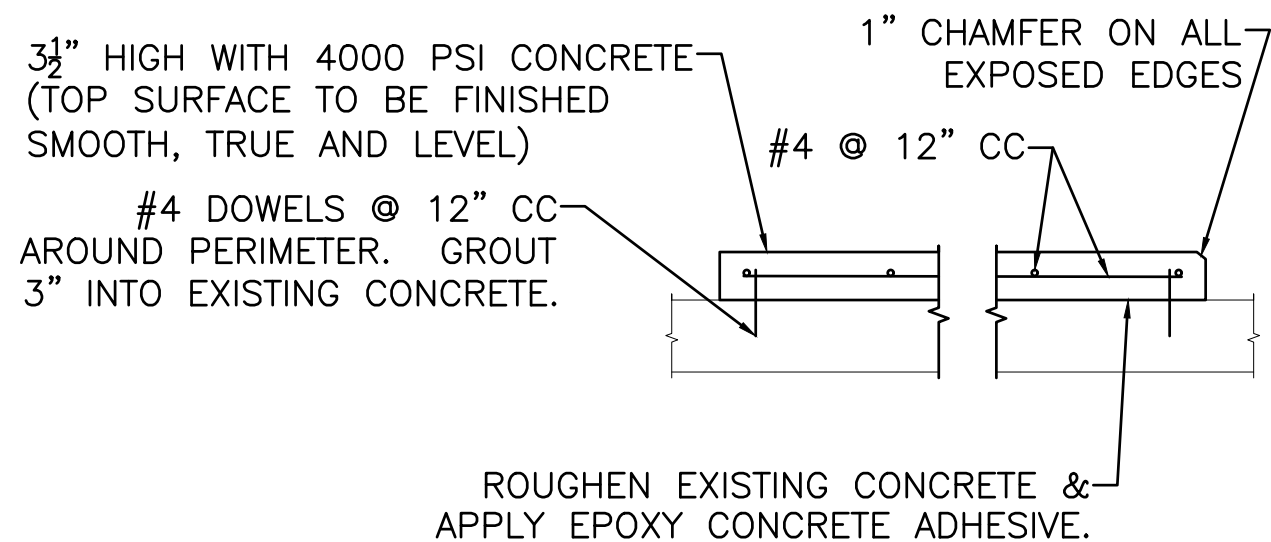
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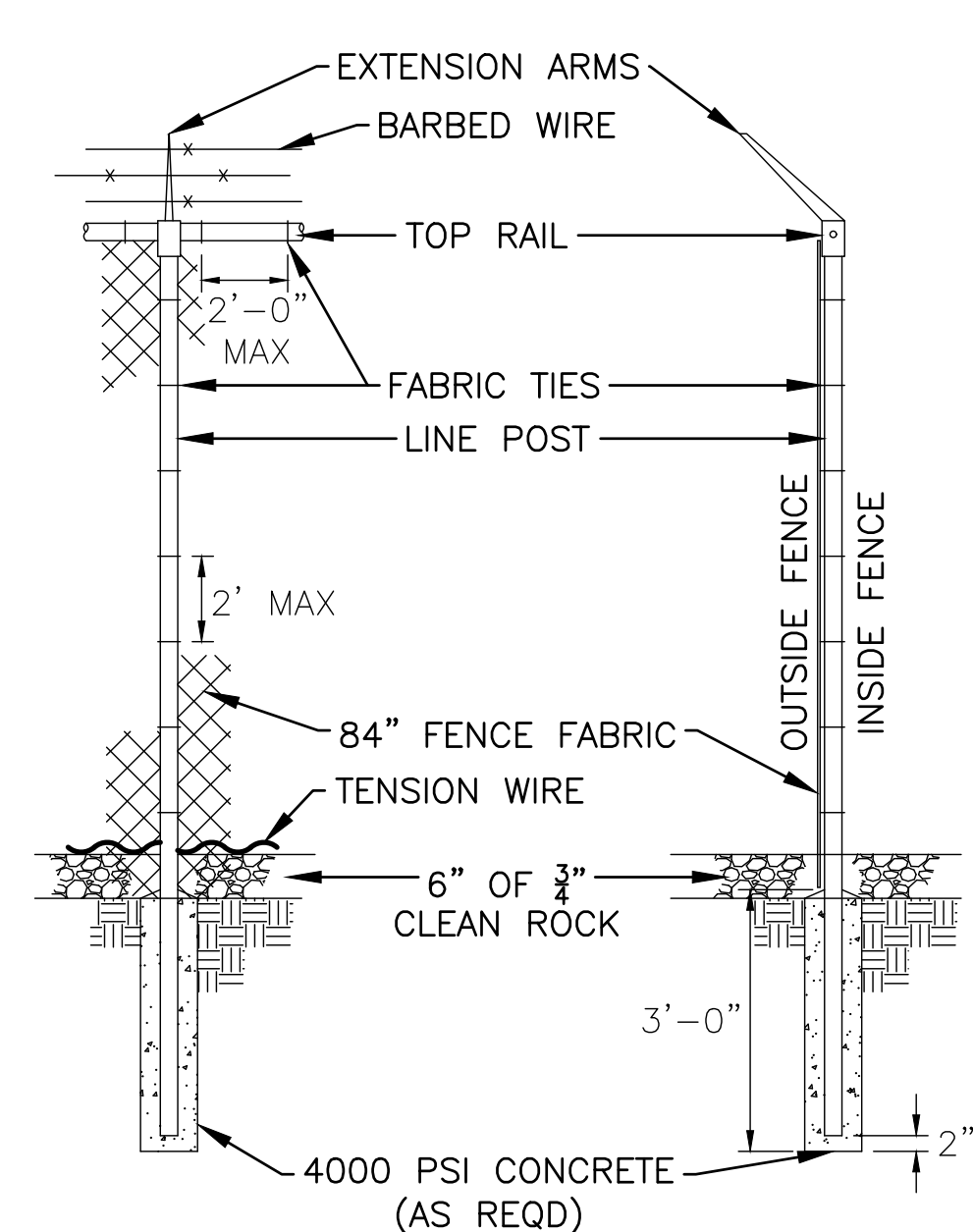
101
E-501
NO SCALE
CONDUIT TERMINATION AT
OUTDOOR ELEC EQUIP DETAIL



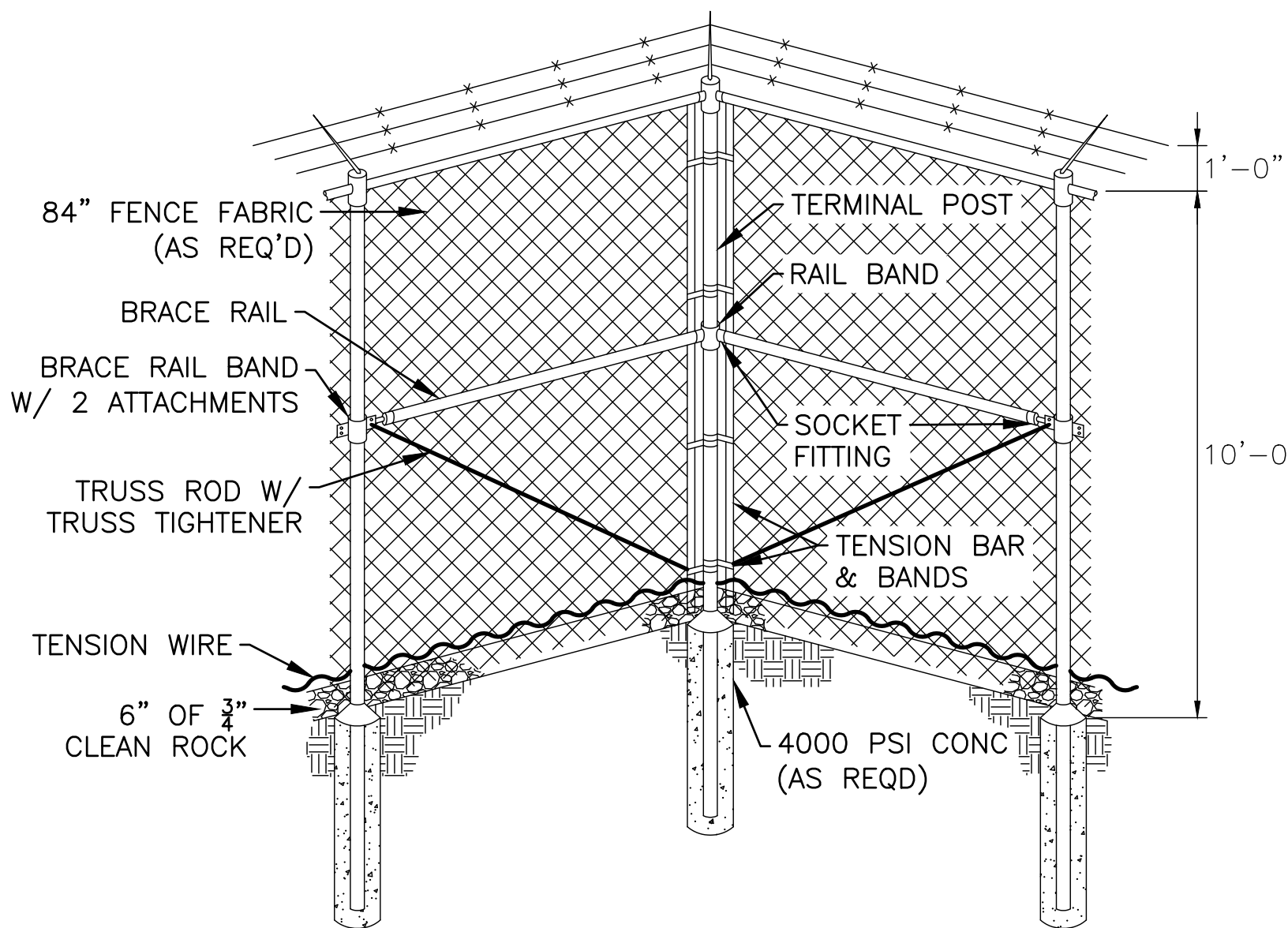
102
E-501
NO SCALE
OUTDOOR EQUIPMENT PAD DETAIL



103
E-501
NO SCALE
INDOOR EQUIPMENT PAD DETAIL

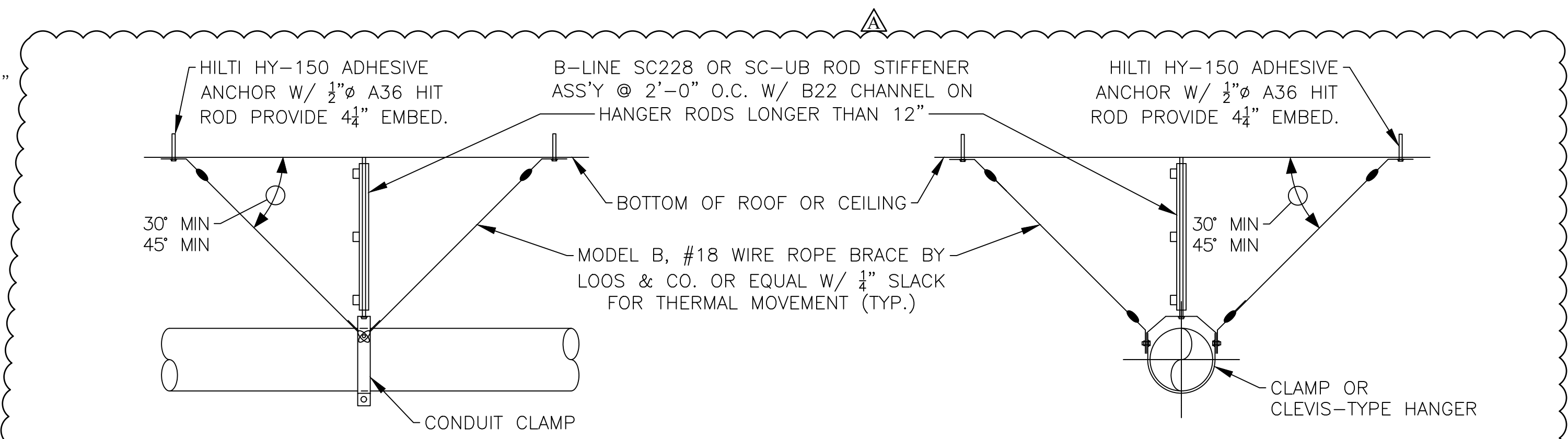


104
E-501
NO SCALE
SECTION



105
E-501
NO SCALE
SECTION

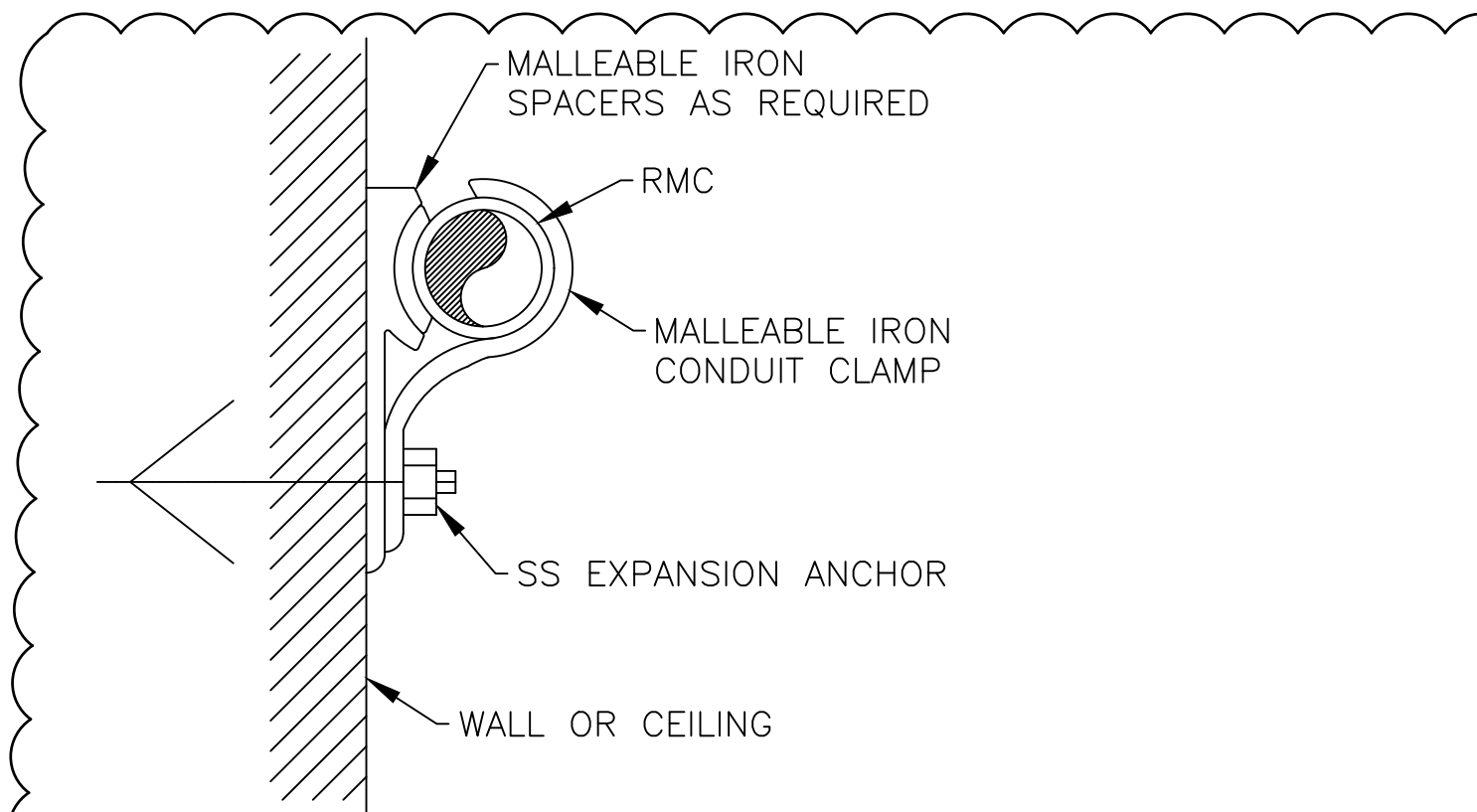
106
E-501
NO SCALE
CORNER SECTION



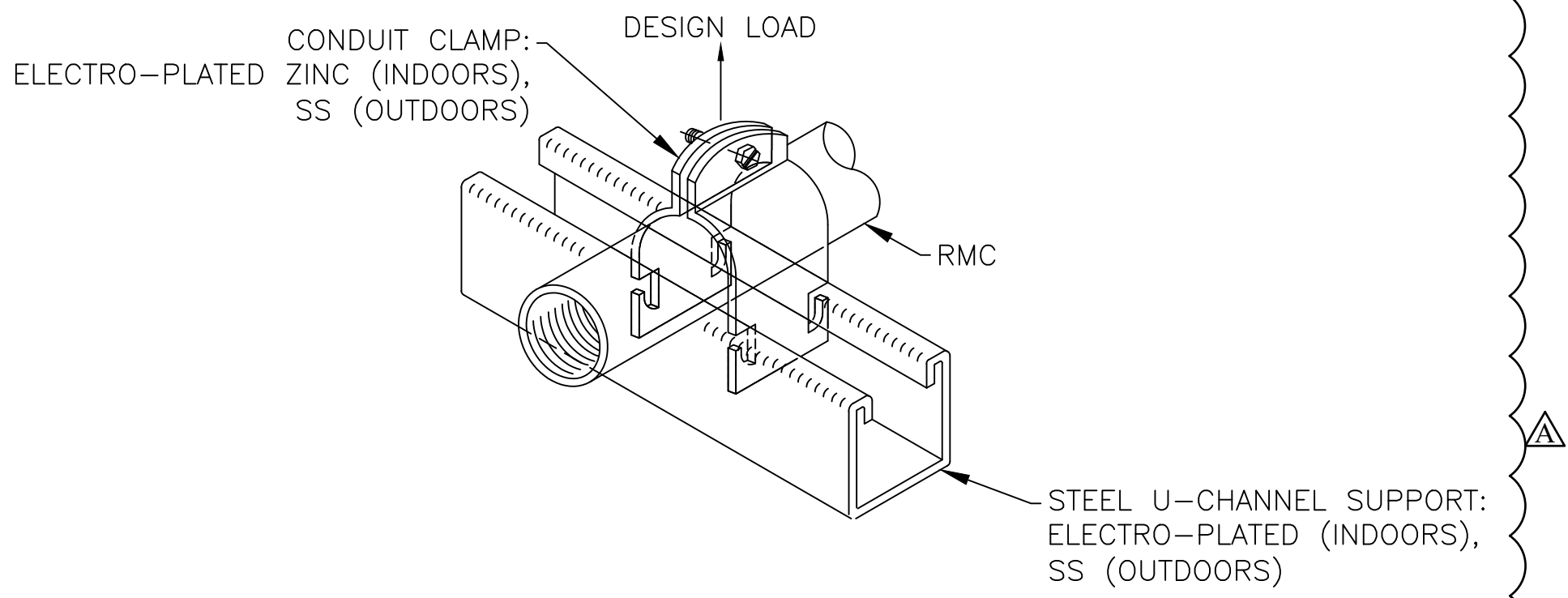
107
E-501
NO SCALE
TYPICAL LONGITUDINAL
CONDUIT BRACING DETAIL

108
E-501
NO SCALE
TYPICAL TANSVERSE
CONDUIT BRACING DETAIL

AMEREN MISSOURI SUBSTATION FENCE DETAILS



109
E-501
NO SCALE
CONCRETE/MASONRY WALL/CEILING
CONDUIT MOUNTING DETAIL



110
E-501
NO SCALE
U-CHANNEL CONDUIT
SUPPORT MOUNTING DETAIL

KEY NOTES:

1. SET EQUIPMENT ON CONCRETE PAD IN PROPER LOCATION. DO NOT SLIDE ON CONCRETE TO AVOID DAMAGING PROTECTIVE FINISH ON BOTTOM
2. EARTH FORMING OF DUCT BANKS SHALL BE PERMITTED ONLY IN AREAS WHERE SIDES AND BOTTOM OF DUCT BANK TRENCH CONSIST OF FIRM UNDISTURBED SOIL.
3. ALL SPARE DUCT BANK CONDUITS SHALL CONTAIN A PULL STRING IN ACCORDANCE WITH THE SPECIFICATIONS.



BARRY D. FREINER
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MO # E-24220
Expires 12-31-2026

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5201 SOUTH MORLEY ST.
MOBERLY, MO 65270

PROJECT # C1920-01
SITE # 7005
ASSET # 9327005051

REVISION: _____
DATE: _____
REVISION: _____
DATE: _____
REVISION: ADDENDUM 2
DATE: 11/07/2025
ISSUE DATE: 09/22/2025

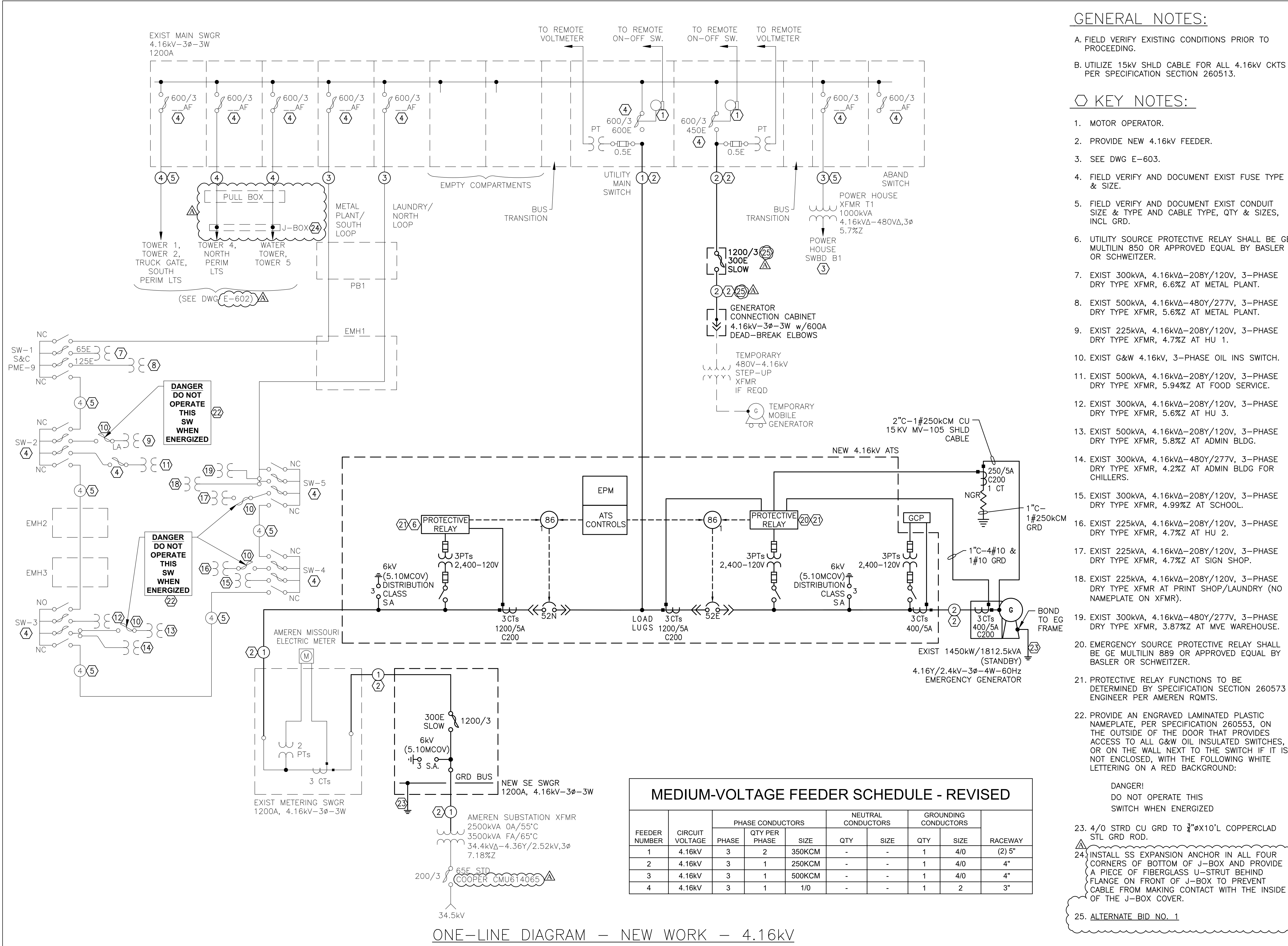
CAD DWG FILE: C1920-01-7005-
9327005051-E-501.DWG
DRAWN BY: K E T
CHECKED BY: B D F
DESIGNED BY: B D F

SHEET TITLE:
ELECTRICAL &
FENCE DETAILS

SHEET NUMBER:

E-501

23 OF 28 SHEETS
SEPTEMBER 22, 2025



GENERAL NOTES:

- A. FIELD VERIFY EXISTING CONDITIONS PRIOR TO PROCEEDING.
- B. UTILIZE 15KV SHLD CABLE FOR ALL 4.16KV CKTS PER SPECIFICATION SECTION 260513.

KEY NOTES:

- MOTOR OPERATOR.
- PROVIDE NEW 4.16KV FEEDER.
- SEE DWG E-603.
- FIELD VERIFY AND DOCUMENT EXIST FUSE TYPE & SIZE.
- FIELD VERIFY AND DOCUMENT EXIST CONDUIT SIZE & TYPE AND CABLE TYPE, QTY & SIZES, INCL GRD.
- UTILITY SOURCE PROTECTIVE RELAY SHALL BE GE MULTILIN 850 OR APPROVED EQUAL BY BASLER OR SCHWEITZER.
- EXIST 300kVA, 4.16kVΔ-208Y/120V, 3-PHASE DRY TYPE XFMR, 6.6%Z AT METAL PLANT.
- EXIST 500kVA, 4.16kVΔ-480Y/277V, 3-PHASE DRY TYPE XFMR, 5.6%Z AT METAL PLANT.
- EXIST 225kVA, 4.16kVΔ-208Y/120V, 3-PHASE DRY TYPE XFMR, 4.7%Z AT HU 1.
- EXIST G&W 4.16kV, 3-PHASE OIL INS SWITCH.
- EXIST 500kVA, 4.16kVΔ-208Y/120V, 3-PHASE DRY TYPE XFMR, 5.94%Z AT FOOD SERVICE.
- EXIST 300kVA, 4.16kVΔ-208Y/120V, 3-PHASE DRY TYPE XFMR, 5.6%Z AT HU 3.
- EXIST 500kVA, 4.16kVΔ-208Y/120V, 3-PHASE DRY TYPE XFMR, 5.8%Z AT ADMIN BLDG.
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- EXIST 300kVA, 4.16kVΔ-208Y/120V, 3-PHASE DRY TYPE XFMR, 4.99%Z AT SCHOOL.
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- EXIST 225kVA, 4.16kVΔ-208Y/120V, 3-PHASE DRY TYPE XFMR AT PRINT SHOP/LAUNDRY (NO NAMEPLATE ON XFMR).
- EXIST 300kVA, 4.16kVΔ-480Y/277V, 3-PHASE DRY TYPE XFMR, 3.87%Z AT MVE WAREHOUSE.
- EMERGENCY SOURCE PROTECTIVE RELAY SHALL BE GE MULTILIN 889 OR APPROVED EQUAL BY BASLER OR SCHWEITZER.
- PROTECTIVE RELAY FUNCTIONS TO BE DETERMINED BY SPECIFICATION SECTION 260573 ENGINEER PER AMEREN RQMTS.
- PROVIDE AN ENGRAVED LAMINATED PLASTIC NAMEPLATE, PER SPECIFICATION 260553, ON THE OUTSIDE OF THE DOOR THAT PROVIDES ACCESS TO ALL G&W OIL INSULATED SWITCHES, OR ON THE WALL NEXT TO THE SWITCH IF IT IS NOT ENCLOSED, WITH THE FOLLOWING WHITE LETTERING ON A RED BACKGROUND:

DANGER!
DO NOT OPERATE THIS
SWITCH WHEN ENERGIZED

23. 4/0 STRD CU GRD TO 3/4"ØX10'L COPPERCLAD STL GRD ROD.
24. INSTALL SS EXPANSION ANCHOR IN ALL FOUR CORNERS OF BOTTOM OF J-BOX AND PROVIDE A PIECE OF FIBERGLASS U-STRUT BEHIND FLANGE ON FRONT OF J-BOX TO PREVENT CABLE FROM MAKING CONTACT WITH THE INSIDE OF THE J-BOX COVER.
25. ALTERNATE BID NO. 1

MEDIUM-VOLTAGE FEEDER SCHEDULE - REVISED									
FEEDER NUMBER	CIRCUIT VOLTAGE	PHASE CONDUCTORS			NEUTRAL CONDUCTORS		GROUNDING CONDUCTORS		RACEWAY
		PHASE	QTY PER PHASE	SIZE	QTY	SIZE	QTY	SIZE	
1	4.16kV	3	2	350KCM	-	-	1	4/0	(2) 5"
2	4.16kV	3	1	250KCM	-	-	1	4/0	4"
3	4.16kV	3	1	500KCM	-	-	1	4/0	4"
4	4.16kV	3	1	1/0	-	-	1	2	3"

STATE OF MISSOURI
MIKE KEHOE,
GOVERNOR



BARRY D. FREINER
Registered Professional Engineer
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Expires 12-31-2026

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PROJECT # C1920-01
SITE # 7005
ASSET # 9327005051

REVISION: _____
DATE: _____
REVISION: _____
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REVISION: **ADDENDUM 2**
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ISSUE DATE: 09/22/2025

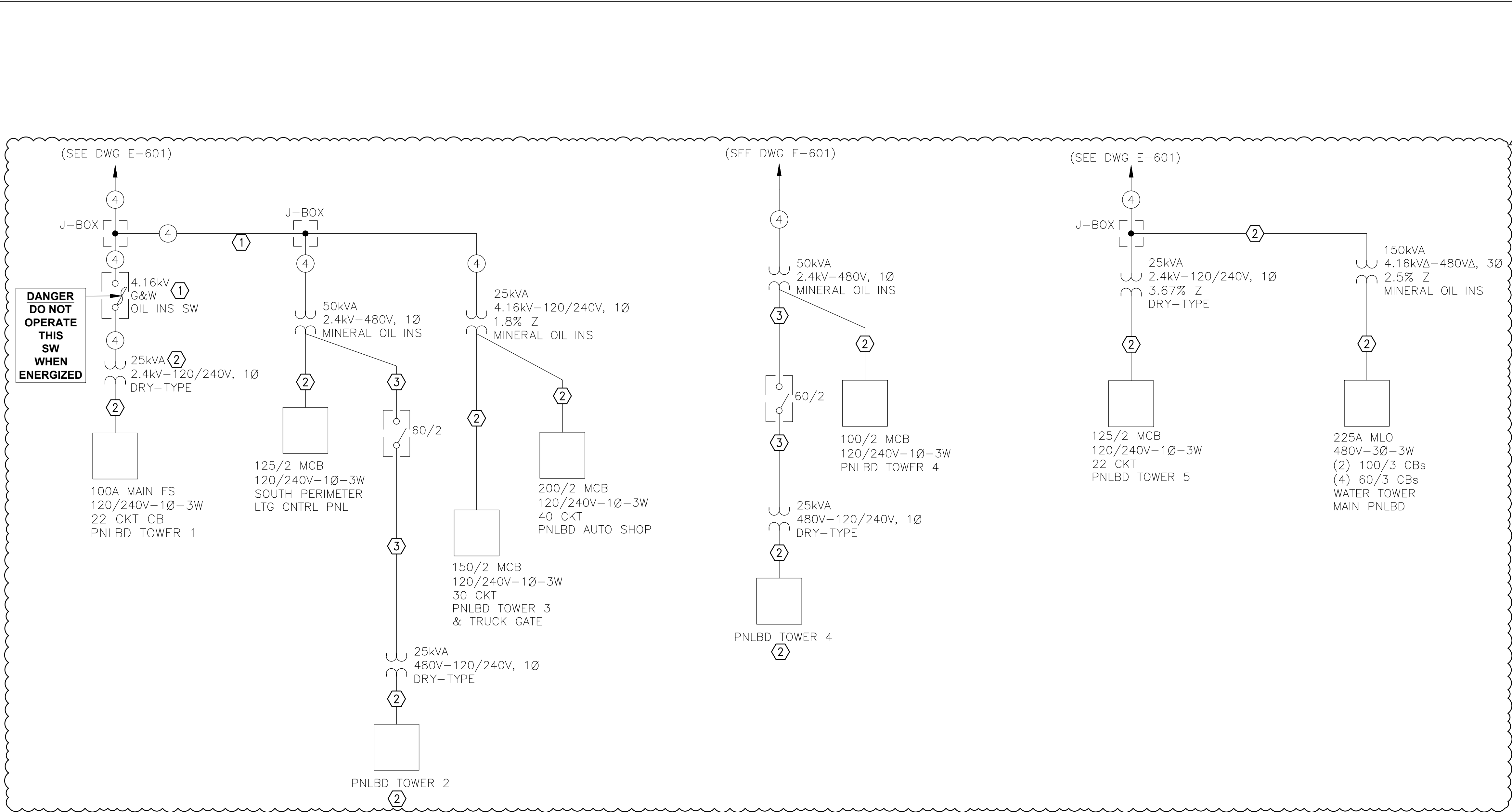
CAD DWG FILE: C1920-01-7005-9327005051-E-601.DWG
DRAWN BY: KET/MNS
CHECKED BY: BDF
DESIGNED BY: BDF

SHEET TITLE:
**ONE-LINE
DIAGRAM - NEW
WORK - 4.16kV**

SHEET NUMBER:

E-601

25 OF 28 SHEETS
SEPTEMBER 22, 2025



ONE-LINE DIAGRAM - NEW WORK

GENERAL NOTE:

- A. FIELD VERIFY EXISTING CONDITIONS PRIOR TO PROCEEDING.
- B. SEE MV FDR SCHED ON DWG E-601.
- C. THIS DWG IS TO BE UPDATED ON RED-LINED AS-BUILT DWGS FROM FIELD VERIFICATION PER KEY NOTES 1 THRU 4 ON DWG ED-602.
- D. PROVIDE AN ARC FLASH HAZARD WARNING LABEL PER SPECIFICATION SECTIONS 260553 AND 260573 ON ALL ELECT EQUIP SHOWN ON THIS DWG.

KEY NOTE:

- 1. PROVIDE AN ENGRAVED LAMINATED PLASTIC NAMEPLATE, PER SPECIFICATION 260553, ON THE OUTSIDE OF THE DOOR THAT PROVIDES ACCESS TO ALL G&W OIL INSULATED SWITCHES, OR ON THE WALL NEXT TO THE SWITCH IF IT IS NOT ENCLOSED, WITH THE FOLLOWING WHITE LETTERING ON A RED BACKGROUND:

DANGER!
DO NOT OPERATE THIS
SWITCH WHEN ENERGIZED
- 2. REFERENCE DATA COLLECTED PER KEY NOTES 1 THRU 4 ON DWG ED-602.
- 3. 2#6

STATE OF MISSOURI
MIKE KEHOE,
GOVERNOR

Professional Engineer Seal for Barry D. Freiner, State of Missouri, License # E-24220, expires 12-31-2026.

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REVISION:	
DATE:	
REVISION:	ADDENDUM 2
DATE:	11/07/2025

ISSUE DATE: 09/22/2025

CAD DWG FILE: C1920-01-7005-9327005051-E-602.DWG

DRAWN BY: KET
CHECKED BY: BDF
DESIGNED BY: BDF

SHEET TITLE:
**ONE-LINE
DIAGRAM - NEW
WORK**

SHEET NUMBER:

E-602

26 OF 28 SHEETS
SEPTEMBER 22, 2025