

SECTION 26 23 00
LOW-VOLTAGE SWITCHGEAR

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation, connection, and testing of low-voltage switchgear, indicated as switchgear in this section.

1.2 RELATED WORK

- A. Section 03 30 00, CAST-IN-PLACE CONCRETE: Requirements for concrete equipment pads.
- B. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Requirement for seismic restraint for nonstructural components.
- C. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
- D. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.
- E. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible fault currents.
- F. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits.
- G. Section 26 05 73, OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY: Short circuit and coordination study, and requirements for a coordinated electrical system.
- H. Section 26 11 16, SECONDARY UNIT SUBSTATIONS: Secondary unit substations.
- I. Section 26 25 11, BUSWAYS: Feeder busways and fittings.
- J. Section 26 43 13, SURGE PROTECTIVE DEVICES: For surge protective devices integral to the switchgear.

1.3 QUALITY ASSURANCE

- A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 FACTORY TESTS

- A. Switchgear shall be thoroughly tested at the factory, with the circuit breakers in the connected position in their compartments. Tests shall be in accordance with IEEE C37.20.1 and NEMA C37.51. Factory tests shall be certified, and shall include the following tests:
1. Design tests.

- 2. Production tests.
- 3. Conformance tests.
- B. The following additional tests shall be performed:
 - 1. Verify that circuit breaker sizes and types correspond to drawings, and the Overcurrent Protective Device Coordination Study.
 - 2. Verify tightness of bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data.
 - 3. Confirm correct operation and sequencing of key-type mechanical interlock systems for multiple circuit breakers by attempting closure on locked-open devices, and attempting to open locked-closed devices, and making key exchange with devices operated in off-normal positions.
 - 4. Verify correct barrier and shutter installation and operation.
 - 5. Exercise all active components.
 - 6. Inspect indicating devices for correct operation.
 - 7. Perform an insulation-resistance test, phase to ground, on each bus section, with phases not under test grounded, in accordance with manufacturer's published data.
 - 8. Perform insulation-resistance tests on control wiring with respect to ground. Applied potential shall be 500 V DC for 300-volt rated cable and 1000 V DC for 600-volt rated cable, or as required if solid-state components or control devices cannot tolerate the applied voltage.
 - 9. If applicable, verify correct function of control transfer relays located in the switchgear with multiple control power sources.
 - 10. Perform phasing checks on double-ended or dual-source switchgear to insure correct bus phasing from each source.
- C. Furnish four (4) copies of certified manufacturer's factory test reports prior to shipment of the switchgear to ensure that the switchgear has been successfully tested as specified.
- D. The Government shall have an option to witness the factory tests. All expenses of the Government Representative's trips to witness the testing will be paid by the Government. Notify the COR not less than 30 days prior to making tests at the factory.

1.5 SUBMITTALS

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1. Shop Drawings:

- a. Switchgear shop drawings shall be submitted simultaneously with or after the Overcurrent Protective Device Coordination Study.
- b. Submit sufficient information to demonstrate compliance with drawings and specifications.
- c. Prior to fabrication of switchgear, submit the following data for approval:
 - 1) Complete electrical ratings.
 - 2) Circuit breaker sizes.
 - 3) Interrupting ratings.
 - 4) Safety features.
 - 5) Accessories and nameplate data.
 - 6) Switchgear one line diagram, showing ampere rating, number of bars per phase and neutral in each bus run (horizontal and vertical), bus spacing, equipment ground bus, and bus material.
 - 7) Elementary and interconnection wiring diagrams.
 - 8) Technical data for each component.
 - 9) Dimensioned exterior views of the switchgear.
 - 10) Dimensioned section views of the switchgear.
 - 11) Floor plan of the switchgear.
 - 12) Foundation plan for the switchgear.
 - 13) Provisions and required locations for external conduit and wiring entrances.
 - 14) Approximate design weights.
- d. Certification from the manufacturer that representative switchgear has been seismically tested to International Building Code requirements. Certification shall be based upon simulated seismic forces on a shake table or by analytical methods, but not by experience data or other methods.

2. Manuals:

- a. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals, including technical data sheets, wiring diagrams, and information for ordering replacement parts.

- 1) Schematic signal and control diagrams, with all terminals identified, matching terminal identification in the switchgear.
 - 2) Include information for testing, repair, trouble shooting, assembly, disassembly, and factory recommended/required periodic maintenance procedures and frequency.
 - 3) Provide a replacement and spare parts list. Include a list of tools and instruments for testing and maintenance purposes.
- b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
3. Certifications: Two weeks prior to final inspection, submit the following.
- a. Certification by the manufacturer that switchgear conforms to the requirements of the drawings and specifications.
 - b. Certification by the Contractor that switchgear has been properly installed, adjusted, and tested.

1.6 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata), form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation only.
- B. Institute of Engineering and Electronic Engineers (IEEE):
- C37.13-08.....Low-voltage AC Power Circuit Breakers Used in Enclosures
- C37.20.1-07.....Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear
- C57.13-08.....Instrument Transformers
- C62.41.1-03.....Surge Environment in Low-voltage (1000V and less) AC Power Circuits
- C62.45-92.....Surge Testing for Equipment connected to Low-Voltage AC Power Circuits
- C. International Code Council (ICC):
- IBC-12.....International Building Code
- D. National Electrical Manufacturers Association (NEMA):
- C37.51-10.....Metal-Enclosed Low Voltage AC Power Circuit Breaker Switchgear Assemblies – Conformance Test Procedures

E. National Fire Protection Association (NFPA):

70-14.....National Electrical Code (NEC).

F. Underwriters Laboratories, Inc. (UL):

891-05Switchboards

977-07.....Safety Fused Power-Circuit Devices

1053-99.....Ground Fault Sensing and Relaying Equipment

1558-99.....Metal-Enclosed Low-Voltage Power Circuit
Breaker Switchgear

PART 2 - PRODUCTS

2.1 GENERAL

A. Shall be in accordance with ANSI, IEEE, NEMA, NFPA, UL, as shown on the drawings, and have the following features:

1. Switchgear shall be a complete, grounded, continuous-duty, integral assembly, metal clad, dead-front, dead-rear, self-supporting, indoor type switchgear assembly.. Incorporate devices shown on the drawings and all related components required to fulfill operational and functional requirements.
2. Switchgear shall be Type 3 front, side, and rear compartmentalized accessible.
3. Ratings shall not be less than shown on the drawings. Short circuit ratings shall not be less than 100 kA.
4. Switchgear shall conform to the arrangements and details shown on the drawings.
5. Key-type mechanical interlocks for multiple circuit breakers shall be provided as shown on the drawings.
6. Switchgear shall be assembled, connected, and wired at the factory so that only external circuit connections are required at the construction site. Split the structure only as required for shipping and installation. Packaging shall provide adequate protection against rough handling during shipment.
7. All non-current-carrying parts shall be grounded per Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS for additional requirements.

2.2 HOUSING

A. Shall have the following features:

1. Frames and enclosures:

- a. The assembly shall be braced with reinforcing gussets using bolted connections or jig welds to assure rectangular rigidity.
 - b. The enclosure shall be steel, leveled, and not less than the gauge required by applicable publications.
 - c. Die-pierce the holes for connecting adjacent structures to insure proper alignment, and to allow for future additions.
 - d. All bolts, nuts, and washers shall be zinc-plated cadmium-plated steel.
2. Circuit breaker compartments:
- a. An individual compartment shall be supplied for each circuit breaker and each future circuit breaker as shown on the drawings. Compartments shall be provided with isolated wireways for control wiring between devices.
 - 1) Separate each compartment so that the circuit breaker, buses, and cable terminations are in separate compartments with steel partitions or barriers of approved and properly installed insulation.
 - 2) Each compartment furnished with a circuit breaker (active or spare) shall be fully equipped as noted on drawings and specified below.
 - 3) Each compartment noted as space for future circuit breaker, as shown on drawings, shall be fully equipped for positioning and connecting the breaker. Provide all equipment required to implement the future breaker installation.
3. Auxiliary compartments:
- a. Compartments shall be provided for auxiliaries, metering, and transition or termination sections as required by the manufacturer, and as shown on drawings. Compartments shall be provided with isolated wireways for control wiring between devices.
4. Compartment doors:
- a. The doors shall permit convenient removal and interchanging of circuit breakers between compartments. The doors shall be capable of a swing approaching 180 degrees.
 - b. Concealed or semi-concealed hinges shall be provided to attach the doors. Weld the hinges to the equipment structure and to the compartment doors.

B. Equipment rear doors:

- a. Provide doors on the rear of the switchgear enclosure for each compartment. Attach the doors by concealed or semi-concealed hinges. Weld the hinges to the enclosure and to the compartment doors. Provide each door with a bolted access .
 - b. The doors shall be capable of a swing approaching 180 degrees and shall be provided with intermediate doorstops.
- C. Finish:
 - 1. All metal surfaces shall be thoroughly cleaned, phosphatized and factory primed prior to applying baked enamel or lacquer finish.
 - 2. Provide a light gray finish for indoor switchgear.
- D. Viewing Ports: Provide infrared inspection window ports so that cable connections may be infrared inspected without opening doors or exposing live parts. Ports may be field installed using Basis of design Product FLIR IR Window sized for each location of incoming and distribution feeder connections.

2.3 BUSES

- A. Bus Bars and Interconnections:
 - 1. Provide insulated copper phase and neutral buses, fully rated for the amperage as shown on the drawings for the entire length of the switchgear. Bus laminations shall have a minimum of 6 mm (1/4 inch) spacing.
 - 2. Mount the buses on appropriately spaced insulators and brace to withstand the available short circuit currents.
 - 3. The bus and bus compartment shall be designed so that the acceptable NEMA standard temperature rises are not exceeded.
 - 4. Install a copper ground bus the full length of the switchgear assembly.
 - 5. All bolts, nuts, and washers shall be zinc-plated cadmium-plated steel. Bolts shall be torqued to the values recommended by the manufacturer.
 - 6. Make provisions for future bus extensions by means of bolt holes or other approved method.

2.4 LOW-VOLTAGE POWER CIRCUIT BREAKERS

- A. General: Circuit breakers shall be dead front, drawout, stored energy type with solid state trip devices. Arcing contacts shall be renewable.

- B. Rating: Circuit breakers shall be 3 pole, 600 volts AC and below, 60 cycle with frame size, trip rating and functions, and system voltage as shown on drawings. Breakers shall have 30 cycle short time current ratings.
- C. Drawout Mounting: Provide a racking mechanism to position and hold the breaker in the connected, test, or disconnected position. Provide an interlock to prevent movement of the breaker into or out of the connected position unless the breaker is tripped open.
- D. Trip Devices: Breakers shall be electrically and mechanically trip free and shall have trip devices in each pole. Unless otherwise indicated on drawings, each breaker shall have overcurrent and short-circuit trip devices with LSI settings, down line zone selective interlocking and communication with remote power management control. Trip devices shall be of the solid state type with adjustable pick-up settings, with both long time and short time elements, and integral trip unit testing provisions. Devices shall have time-delay band adjustment. Long-time delay element shall have inverse time characteristics. Main circuit breakers shall not have instantaneous trip function. Provide nonvolatile memory and field or factory program trip units to store faults and events.
- E. Position Indicator: Provide a mechanical indicator visible from the front of the unit to indicate whether the breaker is open or closed.
- F. Trip Button: Equip each breaker with a mechanical trip button accessible from the front of the door.
- G. Padlocking: Provisions shall be included for padlocking the breaker in the open position.
- H. Operation: Unless otherwise indicated herein or on the drawings, breakers shall be electrically operated.
- I. Provide bus differential monitoring and fault detection including arcing fault detection. Interface with PLC to operate affected breaker or breakers to interrupt fault.
- J. Reduced Energy Let Through (RELT): Provide a maintenance mode for reducing potential arc flash energy. Mode to be selected by the the operator and the RELT status shall display at each breaker.

2.5 BATTERY SYSTEM

- A. Batteries:

1. Provide high discharge rate type maintenance-free nickel-cadmium batteries. Battery voltage shall be 125 volts nominal. Calculate the battery capacity based on the lowest ambient temperature in the room where it is to be installed. Include a safety margin of 50 percent for reserve capacity.
 - a. Provide sufficient battery capacity to carry all continuous loads (lamps, relays, etc.) for 8 hours and then perform the greater of the following duties, with the charger de-energized.
 - 1) Trip all circuit breakers simultaneously or,
 - 2) Close the largest breaker in a line-up of four or less breakers, or close the two largest breakers simultaneously in a line-up of more than four breakers. Breaker closing current shall include both the spring release coil current and the starting current of the spring charging motor.
 2. Provide battery connector covers for protection against external short circuits.
 3. Provide corrosion-resistant steel battery racks.
 4. In seismic areas, batteries shall be secured to the battery rack to prevent overturning during a seismic event. Battery rack shall also be secured to the floor.
- B. Battery Charger:
1. Provide a charger of the full wave rectifier type utilizing silicon controlled rectifiers as the power-control elements. Construction shall be modular with plug-in control units for easy replacement.
 2. The charger shall maintain 1/2 of one percent voltage regulation from no load to full load for line voltage variation of 10 percent, and frequency variation of 3 Hz from 60 Hz.
 3. The charger shall maintain a nominal float voltage of 1.4 vpc, and a nominal equalizing voltage of 1.5 vpc.
 4. The charger shall be capable of continuous operation in an ambient temperature of 40 °C (104 °F) without derating. The charger shall be installed in a convection cooled NEMA Type 1 ventilated enclosure. The housing is to have a hinged front door with all equipment accessible from the front.
 5. Provide both AC and DC transient protection. Charger shall be able to recharge a fully discharged battery without tripping AC protective devices. AC circuit breaker shall not trip under any DC load condition, including short circuit on output terminals.

6. The charger shall be capable of supplying the following demand simultaneously:
 - a. Recharging a fully discharged battery in 12 hours.
 - b. Supervisory panel and control panel.
 - c. Steady loads (indicating lamps, relays, etc.).
7. The charger shall have fused AC input and DC output protection.
8. The charger shall not discharge the batteries when AC power fails.
9. The charger shall have the following accessories:
 - a. On-off control switch with pilot light.
 - b. AC power failure alarm light.
 - c. High DC voltage alarm light.
 - d. Low DC voltage alarm light.
 - e. Ground detection switch and alarm light.
 - f. DC ammeter - 2 percent accuracy.
 - g. DC voltmeter - 2 percent accuracy: Float/equalize voltage marked in red on voltmeter.
 - h. Provisions for activation of remote annunciation of trouble for the above conditions.

2.6 SURGE PROTECTIVE DEVICE

- A. Provide when shown on plans. Refer to Section 26 43 13, SURGE PROTECTIVE DEVICES.

2.7 METERING

- A. As necessary, provide compartment with a front hinged door to provide safe isolated access to meters and all associated terminal and fuse blocks for maintenance, calibration, or testing.
- C. Provide current transformers for each meter. Current transformers shall be wired to shorting-type terminal blocks.
- D. When necessary, Provide voltage transformers including primary fuses and secondary protective devices for metering as shown on the drawings.
- E. Meters to be provided for extension of existing Power Logic Monitoring System. Coordinate with technician and vendor of existing system for this system. See plans for meters.

2.8 OTHER EQUIPMENT

- A. Furnish tools and accessories required for circuit breaker and switchgear test, inspection, maintenance, and proper operation.
- C. Circuit breaker removal equipment: Furnish a portable circuit breaker removal lift and carriage - one for normal power gear and one for emergency power gear; provide permanent circuit breaker removal device

mounted on top of enclosure for installation and removal of circuit breakers.

- D. Remote racking tool: Provide 120V cord connected portable racking tool to permit operator to stand up to 30ft away from breaker to rack breaker. Provide one tool for normal power gear and one for the emergency gear. Provide empty cubicle in switchgear for storage of tool.

2.9 CONTROL WIRING

- A. Switchgear control wires shall not be less than No. 14 AWG copper 600 V rated, labeled as switchgear wiring. Install wiring complete at the factory, adequately bundled and protected. Provide separate control circuit fuses in each breaker compartment and locate for ease of access and maintenance.

2.10 NAMEPLATES AND MIMIC BUS

- A. Nameplates: For Normal Power system, provide laminated black phenolic resin with white core with 12 mm (1/2 inch) engraved lettered nameplates next to each circuit breaker. For Essential Electrical System, provide laminated red phenolic resin with white core with 12 mm (1/2 inch) engraved lettered nameplates next to each circuit breaker. Nameplates shall indicate equipment served, spaces, or spares in accordance with one line diagram shown on drawings. Nameplates shall be mounted with plated screws on front of breakers or on equipment enclosure next to breakers. Mounting nameplates only with adhesive is not acceptable.
- B. Mimic Bus: Provide an approved mimic bus on front of each switchgear assembly. Color shall be black for the Normal Power system and red for the Essential Electrical System, either factory-painted plastic or metal strips. Plastic tape shall not be used. Use symbols similar to one line diagram shown on drawings. Plastic or metal strips shall be mounted with plated screws.

2.11 HMI CONTROL STATIONS

- A. Each low voltage switchgear lineup shall be supplied with a Human Machine Interface (HMI) to view the status of the overall equipment, breakers, electronic devices and other important components as detailed below. The equipment interface shall be a separate HMI-Control-Stack so that operational tasks can be performed on each individual equipment lineup outside the arc-flash boundary.

1. The HMI color view screen will be a backlit liquid crystal display (LCD) and have a minimum diagonal viewing area of at least 15 inches.
 2. The HMI shall also contain at least two USB ports located at the front to provide connection of a USB based devices such as a mouse (mouse not provided), a memory stick to export of files (memory stick not provided) or any other similar USB device.
 3. The HMI-Control-Stack shall also contain a separate keyboard with storage compartment.
- B. The quantity of HMI-Control-Stacks associated with each equipment lineup, that would allow for remote user interface with the equipment lineup shall be one for normal power gear and one for emergency power gear as shown on the project drawings.
- C. To assure maximum uptime and operational reliability the system shall be provided with two Central Processing Units (CPUs). Use of dual/redundant Programmable Logic Controllers (PLCs) with hot backup capability that provide the same parameter functionality will be considered equal.
- D. Provide reliable ongoing 120VAC control power for the two CPUs/PLCs in each HMI-Control-Stack with two Uninterruptible Power Supplies (UPS) - one for each CPU/PLC. The UPSs shall receive their power from the source shown on plans.
- E. The physical placement of the redundant devices (two CPUs/PLCs and two UPSs) shall be contained in the HMI-Control-Stack so that servicing of these components will be remote from the associated LV Switchgear lineup providing an improved safety maintenance environment.
- F. The normal power HMI shall interface and control the Following:
1. Secondary unit substation secondary main breaker (3 units).
 2. Secondary unit substation primary medium voltage breaker.
 3. Normal power switchgear.
- G. Provide interface to other equipment as follows:
1. HMI's shall interface with each other.
 2. Interface with new ATS units.
 3. Interface with existing Cummins Power paralleling gear.
 4. Normal power switchboard Interface with new molded case breaker digital trip units.

2.12 PMCS POWER MONITORING AND CONTROL SYSTEM

- A. Provide a complete electric Power Management and Control System (PMCS) with a PC Based workstation and software for monitoring and control of indicated equipment. Provide communication network with RS-232, RS-485, Modbus, TCP/IP, IEE802.3 protocols for data transfer and to interface with VA facility network. Provide routers and interfaces as required. Provide technicians to coordinate programming and meet with technicians of connected systems. Provide programming time to interface with the connected systems.
- B. System shall be manufactured and setup by the new low voltage switchgear equipment manufacturer.
- C. The following shall be connected to the PMCS:
 - 1. integrate with switchgear HMI's - monitoring only.
 - 2. integrate with new ATS's units - monitoring and test control.
 - 3. integrate with existing generator paralleling gear - monitoring only.
 - 4. integrate with existing Square-D power monitoring system - monitoring only.
 - 5. Integrate with substation transformers for high temperature and leak alarms and temperature monitoring.
 - 6. Integrate with substation primary and secondary breakers.
- D. ATS and generator testing: provide control of ATS testing. Coordinate with manufacturer of ATS units to reliably place ATS in test mode, monitor time in seconds for generator start and ATS swap to emergency power. Maintain a log of generator operation, ATS operation and testing activities. Provide a report generator to print testing by selecting beginning and end calendar dates.
- E. Program custom reports for owner. Include reports for feeder power usage, ATS testing, generator testing, maintenance of switchgear and transformers, lockout/tagout reports. ATS and generator testing reports shall be suitable for submission to JCAHO.
- F. Provide system with an industrial duty computer, hot swappable redundant drives, power supplies and CPU's. system shall allow replacement of drives, power supply or CPU without disrupting operations. Provide access locally through a touch screen.
- G. Program and setup GUI interface for simple access to systems and reports. Screens shall be in one-line format and display live data when applicable.

- H. Coordinate with COR and connect to facility network for remote access to PMCS by facility workstations. Setup at least three remote workstations to have access to PMCS.

2.13. SWITCHGEAR LINE UP AND PROTECTIVE FUNCTIONS.

- A. Provide the following switchgear line ups:
 - 1. Secondary unit substation secondary main breakers.
 - 2. Normal power switchgear in three sections with tie breakers.
 - 3. Emergency power switchgear with main-tie-main.
- B. Zone selective interlocking: The ZSI system shall assure that all circuit breakers will trip for a fault within their respective zone of protection at the set time band. Zone selective interlocking shall be provided for short time and/or ground fault as detailed in the Circuit Breaker Requirements below.
 - 1. The trip time and clearing time of the circuit breakers while operating in the interlocked mode shall be documented in the coordination study and shall be reflected in the Arc Flash Analysis.
- C. Bus differential protection shall be supplied to provide fast fault clearing to reduce potential incident energy on the **normal power switchgear only**.
 - 1. As there is a need for enhanced bus protection and the lessening incident energy without sacrificing selectivity, bus differential protection shall be supplied. This protective function shall be accomplished by either a CPU based single processor system or by a separate/discrete bus differential relay (ANSI 87B device) based system.
 - 2. The line side of every main breaker, the load side of every feeder breaker and both sides of every tie breaker shall have current transformers that provide bus differential instrumentation input. All associated breaker trip wiring, etc. shall be provided.
 - 3. Industrial bus differential devices basis of design are GE Entellisys System, Multilin B Series Relay, Basler BE1-87B Relay, Schweitzer SEL-487B or ABB 87B Relay.
- D. Multi-source ground fault protection is required on the **normal power switchgear only** as there is a need to provide selectivity within the ground fault protection of the lineup.
- E. The switchgear lineup is not arranged to parallel multiple sources and there is no need no need for a sync check function.

- F. Refer to the project drawings for details of the power sources and tie breakers supplying the lineup.
- G. The normal power switchgear ground fault scheme is not a high resistance ground fault type, therefore no HRG detection system is required.
- H. The lineup shall utilize the standard protective settings associated on all the breakers in the lineup and be provided with a low energy let-thru mode where the owner/operator shall be able to select a setting which temporarily lowers the breaker's instantaneous protective function values during a maintenance function. This Administrative Function Maintenance Task shall be initiated from the HMI touch screen in the HMI-Control-Stack.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install switchgear in accordance with the NEC, as shown on the drawings, and as recommended by the manufacturer.
- B. Anchor switchgear with rustproof bolts, nuts, and washers not less than 13 mm (1/2 inch) diameter, in accordance with manufacturer's instructions, and as shown on drawings.
- C. See specification section 13 05 51 Seismic Restraint Requirements for Non-Structural Components: switchgear shall be adequately anchored and braced to withstand the seismic forces at the location where installed.
- D. Interior Location. Mount switchgear on concrete slab. Unless otherwise indicated, the slab shall be at least 100 mm (4 inches) thick. The top of the concrete slab shall be approximately 100 mm (4 inches) above finished floor. Edges above floor shall have 15 mm (1/2 inch) chamfer. The slab shall be of adequate size to project at least 100 mm (8 inches) beyond the equipment. Provide conduit turnups and cable entrance space required by the equipment to be mounted. Seal voids around conduit openings in slab with water- and oil-resistant caulking or sealant. Cut off and bush conduits 75 mm (3 inches) above slab surface. Concrete work shall be as specified in Section 03 30 00, CAST-IN-PLACE CONCRETE.
- E. Install infrared inspection ports at locations allowed for penetration in enclosures and to permit viewing access to lug. Tie cables so as not to obstruct view of lugs.

3.2 ACCEPTANCE CHECKS AND TESTS

A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:

1. Visual Inspection and Tests:

- a. Compare equipment nameplate data with specifications and approved shop drawings.
- b. Inspect physical, electrical, and mechanical condition.
- c. Confirm correct application of manufacturer's recommended lubricants.
- d. Verify appropriate anchorage, required area clearances, and correct alignment.
- e. Verify that circuit breaker sizes and types correspond to approved shop drawings.
- f. Verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey after energization.
- g. Confirm correct operation and sequencing of key-type mechanical interlock systems.
- h. Vacuum-clean switchgear enclosure interior. Clean switchgear enclosure exterior.
- i. Inspect insulators for evidence of physical damage or contaminated surfaces.
- j. Verify correct shutter installation and operation.
- k. Exercise all active components.
- l. Verify the correct operation of all sensing devices, alarms, and indicating devices.
- m. Verify that vents are clear.

2. Electrical tests:

- a. Perform insulation-resistance tests on each bus section.
- b. Perform insulation-resistance test on control wiring; do not perform this test on wiring connected to solid-state components.
- c. Perform phasing check on double-ended switchgear to ensure correct bus phasing from each source.

3.3 FOLLOW-UP VERIFICATION

A. Upon completion of acceptance checks, settings, and tests, the Contractor shall show by demonstration in service that the switchgear is in good operating condition and properly performing the intended function.

3.4 WARNING SIGN

- A. Mount on each entrance door of the switchgear room, approximately 1500 mm (5 feet) above grade or floor, a clearly lettered warning sign for warning personnel. The sign shall be attached with rustproof metal screws.

3.5 ONE LINE DIAGRAM AND SEQUENCE OF OPERATION

- A. At final inspection, an as-built one line diagram shall be laminated or mounted under acrylic glass, and installed in a frame mounted in the switchgear room or in the outdoor switchgear enclosure.
- B. Furnish a written sequence of operation for the switchgear and connected line side/load side electrical distribution equipment. The sequence of operation shall be laminated or mounted under acrylic glass, and installed in a frame mounted in the switchgear room or in the outdoor switchgear enclosure.
- C. Deliver an additional four copies of the as-built one line diagram and sequence of operation to the COR.

3.6 AS-LEFT TRIP UNIT SETTINGS

- A. The trip unit settings shall be set in the field by an authorized representative of the switchgear manufacturer per the approved Overcurrent Protective Device Coordination Study in accordance with Section 26 05 73, OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY. Verify settings with primary injection testing.
- B. Post a durable copy of the "as-left" trip unit settings in a convenient location in the switchgear room. Deliver four additional copies of the settings to the COR. Furnish this information prior to the activation of the switchgear.

3.7 INSTRUCTION

- A. Furnish the services of a factory-trained technician for two, 4-hour training periods for instructing personnel in the maintenance and operation of the switchgear, on the dates requested by the COR.

---END---