

SECTION 26 24 13

LOW VOLTAGE (LV) SWITCHBOARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. The scope of this section includes providing and assembling materials and equipment for the dead-front, low-voltage (600 V or less) distribution switchboard sections of the Unit Substations.
- B. Reference to Manufacturer in this section is to be considered the switchboard manufacturer.
- C. Related Work: Consult below listed Sections, determine the extent and character of related scope and coordinate work specified herein.

SECTION 26 05 00 – COMMON WORK RESULTS FOR ELECTRICAL

SECTION 26 05 48 – VIBRATION CONTROLS FOR ELECTRICAL SYSTEMS

SECTION 26 05 53 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

SECTION 26 12 16 – MEDIUM (MV) VOLTAGE DRY-TYPE TRANSFORMERS

SECTION 26 13 16 – MEDIUM (MV) VOLTAGE FUSIBLE INTERRUPTER
SWITCHGEAR

1.2 REFERENCES

- A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:
 - 1. FS W-C-375 - Circuit Breakers Molded Case, Branch Circuit and Service
 - 2. IEEE C62.41 - Recommended Practice on Surge Voltages in LV AC Power Circuits.
 - 3. NEMA AB 1 - Molded Case Circuit Breakers
 - 4. NEMA PB 2 -Dead Front Distribution Switchboards
 - 5. NEMA PB 2.1- Instructions for Safe Handling, Installation, Operation and Maintenance of Deadfront Switchboards Rated 600 Volts or less
 - 6. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
 - 7. NFPA 70 – National Electrical Code (NEC)
 - 8. UL 486A - Wire Connectors and Soldering Lugs for use with Copper Conductors
 - 9. UL 489 - Molded- Case Circuit Breakers and Circuit Breaker Enclosures
 - 10. UL 891 - Dead-Front Electrical Switchboards

1.3 SUBMITTALS

- A. Submit the following items with bid proposal response:
 - 1. Shop drawings to include:
 - a. Front, plan and side view elevations with overall dimensions.

- b. Conduit entrance locations and requirements.
 - c. Single line & schematic diagrams.
 - d. Electrical characteristics including voltage, frame size and trip rating, and withstand ratings.
- B. Submit the following items within two business days of request by Owner's Representative:
1. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
 2. Shop drawings which shall include:
 - a. Front, plan and side view elevations with overall dimensions.
 - b. Conduit entrance locations and requirements.
 - c. Size and number of bus bars per phase, neutral, and ground.
 - d. Line and Load lug types and requirements.
 - e. Cable terminal sizes.
 - f. Switchboard instrument details and accessories.
 - g. Single line & schematic diagrams.
 - h. Electrical characteristics including voltage, frame size and trip rating, and withstand ratings.
 - i. Submit manufacturer's installation instructions.
- C. Submit the following items one week prior to delivery of the switchboard:
1. Complete Bill of Material listing all components.
 2. Submit Field Test reports.
 3. Nameplates Legends.
 4. Anchorage details including details of vibration insulators installation. (provided by others).
 5. Submit seismic anchorage calculations prepared by a professional structural engineer registered in the State of Texas.
 6. Operations and maintenance manuals.
 7. Warranty
- D. Dimensions and configurations of switchboards shall conform to the space allocated on the Drawings. The Manufacturer shall submit a revised layout if equipment furnished varies in size from that shown on drawings for the Owner's Representative approval.
- E. Operation and Maintenance manuals submittals shall include the following:
1. A detailed explanation of the operation of the system
 2. Instructions for routine maintenance
 3. Pictorial parts list and part numbers
 4. Telephone numbers for the authorized parts and service distributors.
 5. Final testing reports
 6. Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.4 QUALIFICATIONS

- A. The manufacturer of the switchboard shall be the same manufacturer of the major components within the switchboard and the manufacturer of the medium voltage switchgear provided in Section 26 13 16.
- B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.
- C. The equipment shall be seismic tested or qualified per local building code.
 - 1. The equipment and major components shall be suitable for and certified to meet all applicable seismic requirements of the International Building Code (IBC) for the applicable Site Classification.
 - 2. Guidelines for the installation consistent with the IBC requirements shall be provided by the equipment manufacturer and based upon testing of representative equipment. Equipment certification acceptance criteria shall be based upon the ability for the equipment to be returned to service immediately after a seismic event within the above requirements without the need for repairs.

1.5 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the units specified herein shall be new.
- B. Manufacturer shall pay for the services of a qualified testing agency to perform the specified factory tests of paragraph 3.3 FACTORY TESTS of this section. The Manufacturer shall notify the Owner's Representative at least five (5) working days in advance of performance of work requiring testing. The Manufacturer shall provide all material required for testing.
- C. Manufacturer shall pay for the services of a Manufacturer's technician to perform the specified field tests of paragraph 3.5 FACTORY TESTS of this section. The Manufacturer shall notify the Owner's Representative at least five (5) working days in advance of performance of work requiring testing. The Manufacturer shall provide all material required for testing.
- D. Qualifications: The testing agency(ies) shall be a member of International Electrical Testing Association and specializing in testing products specified in this section with minimum five years of documented experience.
- E. Manufacturer warranty for switchboard shall be for two years commencing of the date of successful energizing of equipment following completion of all required testing.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery: Switchboard components shall not be delivered to the site until protected storage space is available. Storage outdoors covered by rainproof material is not acceptable. Equipment damaged during shipment shall be replaced and returned to manufacturer at no additional cost to the Owner's Representative. Components shall be properly packaged in factory-fabricated containers and mounted on shipping skids.
- B. Storage: Store in a clean, dry, ventilated space free from temperature extremes. Maintain factory wrapping or provide a heavy canvas/plastic cover to protect units from dirt, water, construction debris, and traffic. Provide heat where required to prevent condensation.
- C. Handling: Handle in accordance with NEMA PB2.1 and manufacturer's written instructions. Be careful to prevent internal component damage, breakage, denting and scoring. Damaged units shall not be installed. Replace damaged units and return equipment to manufacturer.

1.7 WARRANTY

- A. Equipment and components offered under this Section shall be covered by a two (2) year parts and labor warranty for malfunctions resulting from defects in materials and workmanship.
- B. Manufacturer warranty for switchboard shall be for two years commencing of the date of successful energizing of equipment following completion of all required testing.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, the following:
 - 1. Square D
 - 2. Eaton (Cutler-Hammer)
 - 3. General Electric Company; GE Energy Management - Electrical Distribution.
 - 4. Siemens

2.2 RATINGS

- A. The assembly shall be rated to withstand mechanical forces exerted during short-circuit conditions when connected directly to a power source having available fault current 100,000 amperes symmetrical at rated voltage unless noted otherwise on the drawings.
- B. Voltage ratings shall be as indicated on the drawings.

2.3 CONSTRUCTION

- A. The entire switchboard shall be of unit construction with all parts designed, manufactured, and assembled by a single manufacturer to assure coordination between all items.
- B. Switchboard shall consist of the required number of vertical sections bolted together to form a rigid assembly. The sides and rear shall be covered with removable bolt-on covers. All edges of front covers or hinged front panels shall be formed. Provide adequate ventilation within the enclosure.
- C. The design of all current carrying devices or parts of switchboards shall conform to the standard specified in the related sections of UL No. 891 and National Electrical Manufacturer's Association (NEMA) Standard PB-2, except as these characteristics may be modified herein.
- D. The switchboards shall be floor mounted, self-supporting, dead-front and rear, front operated, front connected, distribution type, manufactured complete with all parts, fittings and equipment, including buses, circuit breakers, barriers, terminals, wiring and connections. The enclosure shall be 90" high, made of cold rolled steel on a structural shape, or formed, steel frame and shall be mounted on two 3 inch-5lb. continuous channel iron sills, which shall be closed at the ends between the two channels.
- E. All serviceable components shall be front accessible.
- F. Overall switchboard dimensions shall fit within the areas allotted on the drawings,
- G. Alignment with other sections (front or rear) will be selected by the Owner's representative. Manufacturer will submit preferred alignment in initial shop drawings.

- H. All switchboard sections shall be a minimum of 24" deep and shall be constructed of National Electrical Code (NEC) gage steel. All holes, supports, studs and openings shall be standardized to enable interchange of interior and front cover units. All sections shall be fabricated with right angle corners, plumb edges and surfaces. All switchboard sections shall line up evenly, front and rear.

2.4 BUS

- A. All bus bars shall be silver-plated copper. Main horizontal bus bars shall be mounted with all three phases arranged in the same vertical plane. Bus sizing shall be based on NEMA standard temperature rise criteria of 65°C over a 40°C ambient (outside the enclosure).
- B. Provide a full capacity neutral bus where a neutral bus is required.
- C. Bus bars, connection bars and wiring on the back of the switchboard shall be arranged so that all accessibility is provided for cable connections from the front.
- D. Electrical clearance between parts of opposite polarity, and between live parts and ground, shall conform to the National Electrical Code (NEC).
- E. Each distribution section shall be bused for the full-connected load and for the full height of that section. Bussing in all sections shall extend to all future circuit breaker "spaces" and shall be drilled for future breakers. Future circuit breaker spaces shall be ready for the installation of all future circuit breakers.
- F. All bus bars shall be 98% conductivity copper. All bus bars and connections, except as noted herein, shall be applied on the basis of the minimum cross-sections required for the circuit ampere rating. Bus bar strength shall withstand strains imposed by starting and short-circuit current. Connections between horizontal and vertical runs of bus bars shall be made with the same size bars as the vertical run bars.
- G. Ampere ratings for rectangular bus bars shall be in accordance with the temperature rise standard of NEMA and UL. Bus size shall not be smaller than the main circuit breaker frame size.
- H. All connections between bus bars shall be of a bolted-type. Clamps will not be accepted. All bus bars shall be accurately formed, and all holes shall be made in a manner that will permit bus bars and connections to be fitted into place without being forced.
- I. Bolts, nuts and washers used to maintain contact on bus and connection bars shall be non-ferrous material, zinc-electroplated steel, or of other corrosion resistant processed steel.
- J. Current carrying nuts shall be made of copper alloy having adequate conductivity and shall be of size to carry the circuit current without exceeding the temperature rise normally specified for copper. Current carrying nuts shall be silver-plated when they are used with connections that are silver-plated.
- K. All connections between bus bars shall be made by drilling and tapping the bus bars and attaching the breakers or jumper bars with cap screws
- L. All bus and connection bars and current potential transformers shall be rigidly supported. No magnetic material shall be located between phase conductors.
- M. All nuts and connections shall be fitted with locking devices to prevent loosening.

- N. A copper ground bus shall be secured to each vertical section structure and shall extend the entire length of the switchboard.
- O. All hardware used on conductors shall be high-tensile strength and zinc-plated. All bus joints shall be provided with conical spring-type washers.

2.5 WIRING/TERMINATIONS

- A. Small wiring, necessary fuse blocks and terminal blocks within the switchboard shall be furnished as required. Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's wiring diagrams.
- B. Mechanical-type terminals shall be provided for all line and load terminations suitable for copper or aluminum cable rated for 75°C of the size as indicated on the drawings.
- C. Lugs shall be provided in the incoming line section for connection of the main grounding conductor. Additional lugs for connection of other grounding conductors shall be provided as indicated on the drawings.
- D. All wiring gutters shall extend the full length and depth of the switchboard.
- E. All control wire shall be type SIS, bundled and secured with nylon ties. Insulated locking spade terminals shall be provided for all control connections, except where saddle type terminals are provided integral to a device. All current transformers secondary leads shall first be connected to conveniently accessible short-circuit terminal blocks before connecting to any other device. All groups of control wires leaving the switchboard shall be provided with terminal blocks with suitable numbering strips. Provide wire markers at each end of all control wiring.

2.6 PROTECTIVE DEVICES

- A. All circuit protective devices shall be group mounted.
- B. Protective devices shall be molded case circuit breakers with inverse time and instantaneous tripping characteristics.
- C. Circuit breakers shall be operated by a toggle-type handle and shall have quick-make, quick-break operating mechanisms with trip-free feature to prevent contacts being held closed against overcurrent conditions in the circuit. Trip position of the breakers shall be clearly indicated by operating handles moving to a center position.
- D. Circuit breakers shall have interrupting capacity not less than 100,000 RMS symmetrical amps. Series connected rating is not acceptable.
- E. Covers shall be sealed on non-interchangeable breakers, and trip unit covers shall be sealed on interchangeable trip breakers to prevent tampering. Circuit breaker ratings shall be clearly visible after installation, or engraved nameplates shall be provided stating the rating. All ferrous parts shall be plated to minimize corrosion.
- F. Multi-pole breakers shall have a single handle to open and close all contacts simultaneously in both manual operation and under automatic tripping. Inter-pole barriers shall be provided inside the breaker to prevent any phase-to-phase flashover. Each pole of the breaker shall have means for Arc extinguishing.
- G. All terminals shall be rated at 75°C minimum for copper conductors.

- H. All circuit breakers with trip ratings 401 amps and larger shall have electronic trips with the following characteristics:
 - 1. Electronic true RMS sensing trip, adjustable via current plug.
 - 2. Certified for operation at 100% of the rated ampacity.
 - 3. Adjustable long time setting and delay.
 - 4. Adjustable short time pick-up and delay.
 - 5. Adjustable instantaneous pick-up.
 - 6. Ground Fault as indicated or where required by code.
 - 7. Mechanical targets on overload, ground fault, and short circuit.
 - 8. Basic power monitoring and metering functions.
 - 9. Arc maintenance switch.
 - 10. Status reporting via standard Modbus communication interface compatible with power logic or equal installation.
 - 11. All adjustments shall be made using non-removable, discrete stop, high reliability switching plug for precise settings. A sealable transparent cover shall be provided over the adjustments to prevent tampering.
- I. Spaces in the boards shall be able to accept any combination of 1, 2 or 3 pole circuit breakers as indicated. Provide all necessary bus, device supports and mounting hardware sized for frame, not trip rating.
- J. The frame size for breakers with trip rating 110 amps and larger shall be minimum 10% larger than the trip rating.
- K. Provide main bus surge protection rated to 250 KA.
- L. All control power requirements shall be fed from an integral transformer within each switchboard.

2.7 ACCESSORIES AND OTHER DEVICES

- A. Provide shunt trips, bell alarms and auxiliary switches as shown on the contract drawings and required by specification.

2.8 CUSTOMER METERING

- A. Where indicated on the drawings, provide a separate customer metering compartment with a front facing hinged door and include the following:
 - 1. Current transformers for each meter. Current transformers shall be wired to shorting-type terminal blocks.
 - 2. Potential transformers including primary and secondary fuses with disconnecting means for metering as shown on the drawings.
 - 3. Microprocessor-Based Metering System shall be Square D PowerLogic ION6200 series, Eaton IQ DP-4000 series or approved equal.

2.9 MISCELLANEOUS

- A. The switchboard shall be provided with cable pull section at the top or bottom of the switchboard, depending upon the location of the incoming and outgoing feeders. Provide a minimum 12" of vertical clearance between the cable terminal lugs bolted to the switchboard buses and the top and bottom of the switchboard enclosure. Horizontal pull sections and gutters

shall be kept free and clear of buses. Where busses cross vertical pull sections, the busses shall be insulated.

- B. Load connections shall be provided with mechanical lugs, sized in accordance with the riser diagram, for the cable sizes indicated and shall be so located within the enclosure that not live parts are accessible from wiring gutters. All devices shown on drawings as specified herein and necessary fuse blocks, terminal blocks and interconnecting wiring shall be factory installed. All groups of control wires leaving the switchboard shall be provided with terminal blocks with numbering strips. Clamp type terminals for all incoming and out-going cables shall have a UL stamp for copper conductors.
- C. Connections to current transformers, breakers or other devices or equipment in the panel and connected to the bus shall not be used for bus supports.
- D. 3-phase bus bars shall be color-coded for phase identification with a painted band, minimum 2” wide in accordance with section 26 05 53.
- E. Finish
 - 1. All metal structural and unit parts shall be completely painted so that interior and exterior surfaces have a complete finish coat on and between them.
 - 2. Enclosure shall be thoroughly cleaned, rinsed, pretreated with phosphatizing process followed by sealer rinses and rust inhibitor process and painting.
 - 3. Paint shall be UL recognized acrylic, baked enamel ANSI-61 light gray.
- F. Construction and installation shall meet local seismic code requirements.

PART 3 - EXECUTION

3.1 DELIVERY AND ASSEMBLY

- A. Manufacturer shall deliver all switchboard components to site or other location within 20 miles of the site as directed by the Owner’s Representative.
- B. Switchboard components will be placed at the final placement location on the site by others under observation of the Manufacturer’s technician.
- C. Switchboard shall be assembled at the final placement location by the Manufacturer’s technician.

3.2 PREPARATION

- A. Provide anchorage details, coordinated with the switchboard mounting provision, prepared and stamped by a licensed engineer as stated in Part 1.
- B. Coordinate all requirements for termination of bus and conductors of the transformer provided in Section 26 12 16.

3.3 FACTORY TESTING

- A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of ANSI and NEMA standards.
 - 1. The switchboard shall be completely assembled, wired, adjusted, and tested at the factory.

2. After assembly, the complete switchboard shall be tested for operation under simulated service conditions to ensure the accuracy of the wiring and the functioning of all equipment.
3. The main circuits shall be given a dielectric test of 2200 volts for one (1) minute between live parts and ground, and between opposite polarities.
4. The wiring and control circuits shall be given a dielectric test of 1500 volts for one (1) minute between live parts and ground.

B. The manufacturer shall provide three (3) certified copies of factory test reports.

3.4 ASSEMBLY

- A. Install switchboards in accordance with manufacturer's written instructions, as shown on the drawings and as specified herein.
- B. Handling, storage, installation and energize of switchboards operations performed by the Manufacturer shall be carried out in accordance with latest edition of NEMA Publications PB 2.1.
- C. Freestanding switchboards shall be accurately aligned, leveled and bolted in place on full-length channels.
- D. Provide and install mounting hardware brackets, bus bar drilling and filler pieces for all unused spaces.
- E. Replace any panel pieces, doors or trims having dents, bends, warps or poor fit that may impede ready access, security or integrity.
- F. Check and tighten all bolts and connections with a torque wrench using manufacturer's recommended values.
- G. Complete all connections of the Switchboards to the transformer provided in Section 26 13 16.
- H. Include nameplates and warning signs as specified in Section 26 05 53.
- I. Provide permanent identification for each feeder and piece of equipment by means of plastic laminated nameplates. All nameplates shall conform to requirements of Section 26 05 53.
- J. Switchboards shall be anchored and braced to withstand seismic forces as calculated per Section 26 05 00.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Technician shall perform all quality control electrical testing, calibration and inspection required herein. Testing agencies objectives shall be to:
 1. Assure switchboard installation conforms to specified requirements and operates within specified tolerances.
 2. Field test and inspect to insure operation in accordance with manufacturer's recommendations and specifications.
 3. Prepare final test report including results, observations, failures, adjustments and remedies.
 4. Apply label on switchboard upon satisfactory completion of tests and results.
 5. Verify ratings and settings and make final adjustments.
- B. Field adjustments:

1. The Manufacturer shall perform field adjustments of the protective devices as required to place the equipment in final operating condition. The settings shall be in accordance with the approved short-circuit study, protective device evaluation study and protective device coordination study at no additional cost to the owner.
- C. Owner Witnessed Testing: Allow a period of 2 hours per switchboard for the Owner's Representative to review and final check. This review shall be done when the switchboard is de-energized, therefore plan accordingly.
- D. Testing of overcurrent protective devices shall be done only after all devices are installed and system is energized.
- E. Prefunctional Testing
 1. Provide testing agency with contract documents and manufacturer instructions for installation and testing.
 2. Visual and mechanical inspection:
 - a. Inspect for physical damage, defects alignment and fit.
 - b. Perform mechanical operational tests in accordance with manufacturer's instructions.
 - c. Compare nameplate information and connections to contract documents.
 - d. Check tightness of all control and power connections.
 - e. Check that all covers, barriers, and doors are secure.
 - f. Verify that relays and overcurrent protective devices meet specified requirements.
 3. Electrical Tests
 - a. Insulation Resistance: 1000 volt DC tests for one minute on all 600 volt and lower rated equipment, components, buses, feeder and branch circuits, and control circuits. Test phase-to-phase and phase-to-ground circuits showing less than 10 mega-ohms resistance to ground shall be repaired or replaced.
 - b. Circuit Continuity: All feeders shall be tested for continuity. All neutrals shall be tested for improper grounds.
 - c. Ground Resistance: Test resistance to ground of system and equipment ground connection.
 - d. Test overcurrent protection devices per applicable standards listed in paragraph 12. REFERENCES.
- F. In the event that the system fails to function properly during the testing, as a result of inadequate pretesting or preparation, the Manufacturer shall bear all costs incurred by the necessity for retesting including test equipment, transportation, subsistence and the Owner's Representative's hourly rate.
- G. Replace at no additional cost to the owner all devices that are found defective or do not operate within factory specified tolerances.
- H. Submit the testing agency's final report for review prior to project closeout and final acceptance by the owner. Test report shall indicate test dates, devices tested, results, observation, deficiencies and remedies. Test report shall be included in the operation and maintenance manuals.

3.6 CLEANING

- A. Prior to energizing of switchboards the Manufacturer shall thoroughly clean the interior of enclosure of all construction debris, scrap wire, etc. using manufacturer's recommended materials and methods.
- B. Touch-up paint any marks, blemishes, or other finish damage suffered during assembly.

END OF SECTION