SECTION 26 24 13

LOW VOLTAGE SWITCHBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. The Conditions of the Contract and applicable requirements of Divisions 0 and 1 and Section 26 00 01, “Electrical General Provisions”, govern this Section.

1.2 DESCRIPTION OF WORK:

A. Work Included: Provide low voltage switchboard work as shown, scheduled, indicated, and as specified.

1.3 STANDARDS:

A. Products shall be designed, manufactured, tested, and installed in compliance with the following standards:

1. ANSI C12 Code for Electricity Metering.
2. ANSI C37.13 Low-Voltage AC Power Circuit Breakers.
3. ANSI C37.16 Preferred Ratings for Low-Voltage Power Circuit Breakers.
4. ANSI C37.20 Switchgear Assemblies Including Metal-Enclosed Bus.
5. ANSI C39.1 Requirements for Electrical Analog Indicating Instruments.
6. ANSI C57.13 Requirements for Instrument Transformers.
7. NEMA AB-1 Molded Case Circuit Breakers.
8. NEMA SG-3 Low-Voltage Power Circuit Breakers.
9. NEMA SG-5 Power Switchgear Assemblies.
10. NEMA PB-2 Dead Front Distribution Switchboards.
11. NEMA PB-2.1 - Instructions for Safe Handling, Installation, Operation and Maintenance of Dead Front Switchboards Rated 600 Volts or Less.

1.4 QUALITY ASSURANCE:

A. Manufacturers: Provide products complying with these specifications and produced by one of the following:

1. Cutler-Hammer, Inc.
2. General Electric Company.
3. Square D Company.
4. Siemens.

B. UL Labels: Provide switchboards which have been UL-labeled for service entrance and meet applicable requirements of UL 891.

C. NEMA Compliance: Comply with National Electrical Manufacturers' Association (NEMA) Standard PB2, SG-5 and ANSI C37.20.

D. Interrupting Ratings: Short circuit analysis and coordination study specified in Section 26 05 73 “Short Circuit Analysis/Coordination Study” shall be completed and submitted with switchboard submittal to confirm interrupting rating of submitted equipment is adequate for the point of application in the electrical distribution.

1.5 SUBMITTALS:

A. Shop Drawing submittals shall include, but not be limited to, the following:

1. Switchboard cut sheets with all bus and overcurrent device ratings, capacities, characteristics, features and associated accessories clearly indicated. Cut sheets shall include information on switchboard indicating instruments and instrument transformers.
2. Submit dimensioned drawings of switchboard showing accurately scaled basic units including, but not limited to, auxiliary compartments and components. **[Document provisions for future bus extension.]**
3. Submit schematics and wiring diagrams for metering and controls.
4. The Short Circuit Analysis, Protective Device Coordination Study**[, Emergency Power System Selective Coordination Study]** and Arc Flash and Electrical Hazard Studies specified in Section 26 05 73, "Short Circuit Analysis/Coordination Study" shall be completed and submitted prior to submitting submittals for this section.
5. Additional information as required in Section 26 00 01, "Electrical General Provisions".

1.6 DELIVERY, STORAGE AND HANDLING:

A. Deliver switchboards in factory-fabricated water-resistant wrapping, and mounted on shipping skids.

B. Handle in accordance with NEMA PB2.1 to avoid damage to material components, enclosure, and finish. Switchboard shall be provided with adequate lifting means.

C. Store in a clean, dry space and protect from the weather. Maintain factory-wrapping or provide an additional heavy canvas or plastic cover.

PART 2 - PRODUCTS

2.1 MATERIALS AND COMPONENTS:

A. General: Except as otherwise indicated, provide switchboard manufacturer's standard materials and components as indicated by his published product information, designed and constructed as recommended by the manufacturer and as required for a complete installation.

2.2 DEAD FRONT DISTRIBUTION SWITCHBOARDS:

[VERIFY THE FOLLOWING]

A. General: Provide a factory-assembled, dead front, **[NEMA 1] enclaves shall comply with conditions of NEC. [outdoor weatherproof]** construction, metal-enclosed, self-supporting, switchboard of the voltage, phase, ampacity and short circuit bracing shown.

1. Switchboard shall consist of the required number of front and rear aligned vertical sections bolted together to form one metal-enclosed rigid switchboard. The switchboard shall be designed as a free-standing board with **[front and rear access] [front and side access]**. Multi-section must have 3 access points. Front, rear, & sides.
2. Switchboard shall include all protective devices and equipment as shown with necessary interconnections, instrumentation, and control wiring. Small wiring, necessary fuse blocks, and terminal blocks within the switchboard shall be furnished. All groups of control wires leaving the switchboard shall be furnished with terminal blocks with suitable numbering strips.
3. Switchboards shall have provisions for future expansion minimum 30% anywhere.

B. Enclosure Construction: The switchboard framework shall be fabricated on a die-formed steel base or base assembly, consisting of formed steel and commercial channel welded or bolted together to rigidly support the entire shipping unit for moving on rollers and floor-

mounting. The framework shall be formed code gauge steel, rigidly welded and bolted together to support all coverplates, busing and component devices during shipment and installation.

1. NEMA 1 switchboard sections shall have an open bottom and individually removable top plates for installation and termination of conduit. Top and bottom conduit areas shall be clearly shown and dimensioned on the shop drawings. All front plates used for mounting meters, selector switches or other front-mounted devices shall be hinged, with all wiring installed and laced and with flexibility at the hinged side. All closure plates shall be screw removable and small enough for easy handling by one man. Furnish bus stubs, factory-fabricated with unit, on top of switchboard for proper entrances and exits of busway when shown on the Drawings.

[VERIFY THE FOLLOWING]

2. **[Outdoor weatherproof enclosures shall be provided for switchboard sections as scheduled or shown on the Drawings.]** Furnish bus stubs, factory-fabricated with the enclosure for proper entrance and exit of busway when shown on the Drawings.
3. All steel surfaces shall be chemically cleaned and treated to provide a bond between paint and metal surfaces to prevent moisture entrance and rust formation under the paint film. The paint finish shall be manufacturers standard gray enamel over a rust inhibiting phosphate primer.

[SELECT CONDUCTOR TYPE]

C. Busing: The switchboard busing shall be silver-plated copper, and of sufficient cross-sectional area to continuously conduct rated full load current with a maximum temperature rise of 65°C above an ambient temperature of 40°C.

1. The busbars shall be rigidly braced to comply with the integrated equipment rating of the switchboard. The main horizontal busbars between sections shall be located on the back of the switchboard to permit maximum available conduit area. The horizontal main busbar supports, connections, and joints shall be bolted or welded, as required, so as not to require periodic maintenance. All bolted joints shall be bolted with medium carbon steel, zinc or cadmium-plated hardware equipped with lock washers and torqued to the manufacturer's recommended settings (usually ASTM standards). All bolted connections shall have Belleville washers and witness torque by authority having jurisdiction.
2. Buses shall be arranged A-B-C, left-to-right, top-to-bottom, and front-to-rear throughout. A ground bus shall be secured to each vertical section structure and extend the entire length of the switchboard. Neutral busing, where installed, shall be full capacity rated, unless noted otherwise.
3. Where "space" is shown on one line drawings, space shall be bused for installation of future switches sized as shown. Add spare buss fingore, coordinate with maximum size of space.

[VERIFY THE FOLLOWING]

4. Service switchboard busing shall have lug provisions, where shown, for connection of fire pump feeders ahead of all other circuits.

D. Integrated Equipment Rating: Each switchboard, as a complete unit, shall be given a single integrated equipment rating by the manufacturer. The integrated equipment short circuit rating shall certify that all equipment is capable of withstanding the stresses of a fault equal to that shown in RMS symmetrical amperes. Such ratings shall have been established by actual tests by the manufacturer on similar equipment construction as the subject

switchboard. This test data shall be available and furnished, if requested, with or before the submittal of shop drawings.

E. Indicating Instruments: Provide indicating instruments as specified, scheduled or shown on the Drawings:

1. Current Transformers: ANSI C57.13; 5 ampere secondary, window type, primary/secondary ratio as required; burden and accuracy consistent with connected metering and relay devices, 60 Hz.
2. Potential Transformers: ANSI C57.13; 120 volt secondary, disconnecting type with integral fuse mountings, primary/secondary ratio as required; burden and accuracy consistent with connected metering and relay devices, 60 Hz.

SELECT/EDIT 3. - 8. DIGITAL METERING.

3. Electronic Metering Device: Provide electronic metering devices to meter the main bus as scheduled or shown on the Drawings. Device shall be a Square D Class 3020 PowerLogic Circuit monitor with digital output display or equal by General Electric or Westinghouse. The unit shall be Underwriters' Laboratory listed per UL508.
   a. The electronic metering device shall have a six digit LED readout which will allow local display of the following electrical parameters:
      1) Voltmeter, phase to phase and phase to neutral.
      2) Current, per phase RMS and 3-phase average.
      3) Demand current, per phase.
      4) Power factor, per phase and 3-phase total.
      5) Real power, 3-phase total.
      6) Reactive power, 3-phase total.
      7) Apparent power, 3-phase total.
      8) Energy (MWH).
      9) Reactive Energy (MVARH).
      10) Frequency.
      11) Average demand real power.
   b. The electronic metering device shall have the following additional features and characteristics.
      1) Built-in communications capability which will allow multipoint communication to a remote PC via an RS-485/RS-422 communications port.
      2) Adjustable demand interval (5-60 minutes).
      3) Nonvolatile memory for storing all historical data.
      4) **[A "waveform capture" function to store voltage and current waveforms in memory for analysis via the communications port.]**
   c. Setup of the electronic metering device shall be accomplished from the front of the device. It shall not be necessary to open the front of the enclosure to reach rear-mounted dip-switches. Setup parameters shall include CT ratio, PT ratio, system type (3-wire or 4-wire) and demand interval.
   d. All setup and reset functions shall be keyswitch or password protected to prevent unauthorized or accidental change of value.
      1) The accuracy of the electronic metering device in percent of full scale for various readouts shall be as follows:

2) Current and voltage measurements ± 1%.
3) Power and energy ± 2%.
4) Frequency ± 0.5%.
5) Power factor ± 4%.
6) Data update time 0.817 S (4 wire)

F. Overcurrent Devices:

[VERIFY THE FOLLOWING]

1. General: All protective devices shall be **[individually-mounted] [group-mounted]** and arranged for stationary mounting.

[VERIFY THE FOLLOWING]

2. Molded Case Circuit Breakers - [**1200 amp**] Frame and Larger: Circuit breakers shall be 100% rated, 3-pole devices with ampere rating as shown on the Drawings and additional features as listed below.
   a. Breaker cases shall be constructed from high dielectric strength, glass-reinforced insulating material.
   b. Breakers shall be manually operated and provided with a handle for charging a spring-loaded, quick-make quick-break mechanism. When charged, the stored energy mechanism shall be capable of closing the breaker and still have sufficient capacity to open the breaker before recharging the mechanism.
   c. Breakers shall be stationary-mounted within the switchboard.
   d. Breakers shall be equipped with a solid-state programmable flux shift trip device, and current sensors to control the breaker operation under overload and fault conditions. The solid-state electronic programmable trip device shall have the following features and tripping functions.
      1) Adjustable current setting.
      2) Adjustable long-time delay.
      3) Adjustable instantaneous pick-up.
      4) Adjustable short time delay.
      5) Adjustable short time pick-up.
      6) Adjustable ground fault delay.
      7) Adjustable ground fault pick-up.
   e. Breakers shall have a minimum symmetrical interrupting rating of **[65,000 amperes minimum] [_____ amperes minimum]**, or as scheduled or shown on the Drawings.
   f. Breakers shall be equipped with a factory-installed padlock option over the "OFF" button to prevent charging the mechanism or closing the breaker.

[VERIFY THE FOLLOWING]

3. Molded Case Circuit Breakers - **[800 amp]** Frame and Smaller: Circuit breakers shall be **[100%] [80%]** rated, 3-pole devices with ampere rating as shown on the Drawings and additional features as listed below.
   a. Breakers shall be constructed of a molded case design.
   b. Breakers shall be stationary-mounted within the switchboard.

c. Breakers shall be equipped with a solid-state programmable flux shift trip device, and current sensors to control the breaker operation under overload and fault conditions. The solid-state electronic programable trip device shall have the following features and tripping functions.
   1) Adjustable current setting.
   2) Adjustable long-time delay.
   3) Adjustable instantaneous pick-up.
   4) Adjustable short time delay.
   5) Adjustable short time pick-up.
   6) Adjustable ground fault delay.
   7) Adjustable ground fault pick-up.

d. Breakers shall have a minimum symmetrical interrupting rating of **[65,000 amperes minimum] [_____ amperes minimum]**, or as scheduled or shown on the Drawings.

e. Breakers shall be equipped with a factory-installed padlock option over the breaker handle to prevent closing the breaker.

[VERIFY THE FOLLOWING]

4. Bolted Pressure Contact Switches: Main switches and branch switches 1200 amperes and larger shall be fusible bolted pressure contact switches with ratings as shown. The switches shall be dead front type with a fuse door interlock and provisions for padlocking in the open position with at least three padlocks. The bolted contacts shall firmly bolt the movable blades to both the top and bottom stationary contacts. The switch shall have a quick-make quick-break mechanism. Easily replaceable stationary arc tips and arc chambers shall be used. The switch shall be capable of opening and closing into a fault of six times current-rating in accordance with UL requirements. Bolted pressure switches shall be 100% rated when installed in switchboard enclosure. Switches shall be charge-before-close with an electric trip. Electric trip shall be closed only after the opening spring has been charged ready for opening by electric trip solenoid or manual pushbutton. Provide primary and secondary fused control power transformer for electric trip. **[Main and branch switches shall be provided with blown fuse protection for use with the electric trip.]** A blown fuse indicator light shall be provided.

[VERIFY THE FOLLOWING]

5. Fusible Switches: Branch switches 800 amperes and smaller shall be quick-make quick-break fusible switches with ratings as shown. Each switch shall be enclosed in a separate steel enclosure. The enclosure shall employ a hinged cover for access to the fuses. Cover shall be interlocked with the operating handle to prevent opening the cover when the switch is in the "ON" position. This interlock shall be constructed so that it can be over-ridden for testing fuses without interrupting service. Switches shall have padlocking provisions in the "OFF" position. Switches shall include positive pressure rejection type fuse clips for use with UL Class R fuses and be UL-labeled for 200,000 AIC. Fuses larger than 600 ampere shall be Class "L" bolt-in.

G. Ground Fault Protection: Where specified, scheduled or shown on the Drawings, ground fault protection shall be achieved by integral ground fault sensing in the circuit breaker trip unit with adjustable pickup for ground fault currents, field-adjustable from 100 amperes to 1200 amperes and instantaneous to 60 cycle time delay. The ground fault protection system

shall include all necessary sensors, internal wiring, and relays to coordinate opening faulted circuits monitored.

1. Ground fault trip function shall also have output contacts for breaker/switch tripping and shall incorporate a memory function to recognize and initiate tripping on intermittent ground faults.
2. Ground fault protection shall be set at minimum settings for both current and time during construction. The switchboard manufacturer shall include in the submittal data for the switchboard, the minimum setting of the devices and the recommended setting for normal building operation.
3. The ground fault system shall be factory-tested prior to shipment as specified herein:
   a. The switchboard manufacturer shall provide a factory ground fault protection system test for circuit testing and verification of tripping characteristics. The manufacturer shall pass predetermined values of current through the relay sensors and measure the relay tripping time for each phase and neutral (if required). The measured time current relationships shall be compared to the relay trip characteristic curves. If the relay trips outside the range of values indicated on the curve the relay shall be replaced or recalibrated.
   b. Additional auxiliary, pilot and control relays, electrically operated switches, shunt trip switches, and similar items shall have proper voltages applied to their circuits and satisfactory operation demonstrated.
   c. Upon completion of the factory ground fault protection system test, the current and time on each relay shall be set to their minimum values.

PART 3 - EXECUTION

3.1 INSTALLATION OF SWITCHBOARDS:

A. General: Install switchboards where shown, in accordance with the manufacturer's written instructions and recognized industry practices to ensure that the switchboards comply with the requirements and serve the intended purposes.

B. Standards: Comply with the requirements of NEMA and NEC standards and applicable portions of NECA's "Standard of Installation", for installation of switchboards.

C. Tightness: Torque bus connections must be witnessed by Authority having Jurisdiction and tighten mechanical fasteners.

D. Fuses: Install fuses of the ratings shown in each switchboard, as applicable. All fused over 200 a must be provide 3 spare.

E. Concrete Pads: Install switchboards on a reinforced concrete housekeeping pad. The housekeeping pad shall extend 3" beyond the housing of the switchboard unless shown otherwise. Switchboard shall be bolted to the housekeeping pad using 3/8" minimum galvanized bolts and anchors on 30" maximum centers. Furnish the exact position of any block outs, dimensions, and location of the housekeeping pads in a timely manner so as to prevent delay of the concrete work. Refer to Section 26 05 01, "Electrical Basic Materials and Methods", for additional requirements.

F. Adjustment: Adjust operating mechanisms for free mechanical movement.

G. Finish: Touch-up scratched or marred surfaces to match original finish.

3.2 TESTING:

A. Pre-Energization Checks: Prior to energization, check switchboards for continuity of circuits and for short circuits. All testing documentation must be in order and present at time of energization. Must have Authority present for any over 200a.

B. Switchboard Insulation Resistance Test: Each switchboard bus shall have its insulation resistance tested after the installation is complete except for line and load side connections. Tests shall be made using a Biddle Megger or equivalent test instrument at a voltage of not less than 1000 volt dc with resistance recorded after 30 and 60 seconds of operation at slip speed. Resistance shall be measured from phase-to-phase and from phase-to-ground. Bus which does not meet or exceed manufacturer's bus insulation resistance specifications shall be repaired or replaced and retested until an acceptable resistance is obtained.

C. Ground Fault Protection System Test: Following completion of the construction work and prior to final acceptance testing, the ground fault protection system shall be field-tested and reset to the manufacturer's settings for both current and time by a representative of the manufacturer's engineering service department. The field test shall be conducted in a similar manner to the factory test in that a cable from a low voltage, high-current test set shall be passed through each current sensor. The time and current values for the ground fault function of circuit breakers shall be checked against the ground fault characteristic curves and relays which fail to pick-up within the published curves shall be recalibrated or replaced. This test shall also demonstrate the complete system reliability in that the overcurrent devices shall actually open.

D. Submittals: Contractor shall furnish all instruments and personnel required for tests. Submit four copies of certified test results to Engineer for review. Test reports shall include switchboard tested, date and time of test, relative humidity, temperature, and weather conditions.

E. Thermographic Testing: Refer to Section 26 01 25, "Electrical Testing", for thermographic testing.

F. Contractor shall notify the Owner’s Representative of these test dates 14 days in advance so the tests can be properly witnessed. Submit copies of test reports.

3.3 IDENTIFICATION:

A. General: Refer to Section 26 05 53 , “Identification for Electrical Systems”, for nameplates, identification and warning signs.

B. [Mimic Bus: Provide a mimic bus on each switchboard to show busing, connections, and devices in single line form on an engraved nameplate securely attached on the front panels of the switchboard or shall be painted directly on the switchgear.]

END OF SECTION 26 24 13