SECTION 26 24 14

600 VOLT DRAWOUT SWITCHGEAR

PART 1 - GENERAL

1.01 SECTION INCLUDES:

A. Individually mounted rear-accessible low voltage switchgear ANSI rated switchgear and low voltage power circuit breakers utilized in the switchgear.

1.02 RELATED DOCUMENTS:

A. Refer to Section 01 for additional requirements.
B. Section 26 01 00 - Basic Electrical Requirements.
C. Section 26 05 19 - Low Voltage Power Conductors and Cabling.
D. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
E. Section 26 05 53 - Electrical Identification.
F. Section 26 05 73 - Overcurrent Protective Device Coordination Study.

1.03 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 C39.1	Requirements for Electrical Analog Indicating Instruments
3.	ANSI C57.13	Requirements for Instrument Transformers
4.	NEC	
5.	ANSI C37.16	Low Voltage Power Circuit Breakers and AC Power Circuit Protectors, preferred Ratings, Related Requirements and Application Recommendations
6.	ANSI C37.17	Trip Devices for AC Low Voltage Power Circuit Breakers
7.	ANSI C37.50	Switchgear-Low Voltage AC Power Circuit Breakers Used in Enclosures-Test Procedures
8.	ANSI C37.51	Switchgear – Metal Enclosed Low Voltage Power Circuit Breaker Switchgear
9.	UL 1066	Low Voltage AC and DC Power Circuit Breakers used in enclosures
10.	UL 1558	Metal Enclosed Low Voltage Power Circuit Breaker Switchgear
11.	NEMA SG-5	Power Switchgear Assemblies
12.	NEMA SG-3	Low Voltage Power Circuit Breakers

1.04 QUALITY ASSURANCE:

A. UL Labels: Provide switchgear which have been UL-labeled for service entrance and meet applicable requirements of UL 1558.

B. NEMA Compliance: Comply with National Electrical Manufacturers' Association (NEMA) Standard SG-5 and SG-3.

1.05 SUBMITTALS:

A. Shop Drawing submittals shall include, but not be limited to, the following:
   1. Switchgear cut sheets with all bus and overcurrent device ratings, capacities, characteristics, features and associated accessories clearly indicated. Cut sheets shall include information on switchgear indicating instruments and instrument transformers.
   2. Submit dimensioned drawings of switchgear showing accurately scaled basic units including, but not limited to, auxiliary compartments and components.
   3. Submit schematics and wiring diagrams for metering and controls.

1.06 DELIVERY, STORAGE AND HANDLING:

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

B. Handle in accordance with manufacturer’s instructions to avoid damage to material components, enclosure, and finish. switchgear 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

2.01 MANUFACTURERS:

A. Provide products complying with these specifications and produced by one of the following:
   1. Eaton, Cutler Hammer.
   2. General Electric Company.
   3. Square D Company.
   4. Siemens.

2.02 MATERIALS AND COMPONENTS:

A. General: Except as otherwise indicated, provide switchgear 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.

2.03 DEAD FRONT DISTRIBUTION SWITCHGEAR:

A. General: Provide a factory-assembled, dead front, NEMA 1 construction, metal-enclosed, self-supporting, switchgear of the voltage, phase, ampacity and short circuit bracing shown.
   1. The switchgear shall be furnished with individually mounted main, tie and feeder circuit breakers. Access to the circuit breaker load terminations shall be from the rear of the switchgear. The switchgear cable and bus compartment shall be isolated from the front-accessible protective device compartments by rigid glass-reinforced polyester

barriers. Feeder breakers shall have insulated load bus extensions to the rear cable compartment. It shall be possible to make up the outgoing feeder cable terminations without reaching into or over the switchgear horizontal or vertical busses.

2. The top, bottom and sides of each breaker and instrument compartment shall be isolated from adjacent compartments by grounded steel barriers. Cubicle doors for low voltage power circuit breakers shall not contain any ventilation openings and shall be hinged and provided with a quarter-turn latches. Breaker cubicle door latches shall have padlocking provisions.
3. Closed door drawout shall be provided so that the breakers can be racked out from the connected through test to the disconnect position while the compartment doors remain stationary and closed.
4. Provide shutters in draw-out breaker compartments to cover breaker primary line and load disconnects when the breaker is removed from the compartment.
5. Switchgear shall consist of the required number of front and rear aligned vertical sections bolted together to form one metal-enclosed rigid lineup. The switchgear shall be designed as a free-standing board with rear access to all line and load terminations.
6. Switchgear 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 switchgear shall be furnished. All groups of control wires leaving the switchgear shall be furnished with terminal blocks with suitable numbering strips.
7. Switchgear shall have provisions for future expansion where shown on the Drawings.

B. Enclosure Construction: The switchgear 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 switchgear 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 switchgear for proper entrances and exits of busway when shown on the Drawings.
2. 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

manufacturer's standard gray enamel over rust inhibiting phosphate primer.

3. A traveling type, rail mounted, circuit breaker lifter shall be provided on top of switchgear to provide a means for removal of the circuit breakers.
4. Furnish full height lockable rear hinged doors for each section for access to rear cable compartments.

C. Busing: The switchgear 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 switchgear. The main horizontal busbars between sections shall be in the middle of the switchgear to accommodate rear termination compartment. 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 draw-out breaker primary connections shall be silver-plated.
2. Provide 100%- rated neutral.
3. 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 switchgear. Neutral busing, where installed, shall be full capacity rated, unless noted otherwise.
4. The main horizontal bus and incoming line shall be isolated and insulated from outgoing busing and cable connections.
5. Provide fully equipped spaces for future devices with bussing and bus connections, suitably insulated and braced for short circuit currents, as indicated on Drawings.

D. Integrated Equipment Rating: Each switchgear, 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 switchgear. 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.

3. Provide a meter for the switchgears as shown on the drawings similar and approved equal by UH FP&C to a PowerLogic CM4250 circuit monitor, with vacuum fluorescent display, and I/O module.
    a. The Monitor shall withstand 200% rated current continuously. It shall withstand 10X rated current for at least 3 seconds. Isolation shall be no less than 2500V AC.
    b. Surge withstand shall conform to IEEE C37.90.1,62.41 and IEEE 1000-4.
    c. Shall have a standard ANSI C39.1 case mount.
    d. The Monitor shall provide true RMS measurements of voltage, phase to neutral and phase to phase; current, per phase and neutral; real power, reactive power, apparent power, power factor and frequency.
        1) The Monitor must be capable of providing readings for both instantaneous and average readings.
        2) The Monitor must also be capable of providing all single phase real, apparent, reactive power and power factor values.
        3) The Monitor shall record and store total bi-directional energy. It shall include separate registers for positive and negative energy.
        4) The Monitor shall record and store total bi-directional accumulated energy and total accumulated apparent energy.
        5) The Monitor shall monitor max/min average demand values for all current and power readings. The demand interval shall be user programmable. Maximum and minimum values shall be stored with a date/time stamp.
    e. The Monitor shall have an accuracy of +/- 0.1% or better for volts and amps, and 0.2% for power functions, and shall meet IEC687 (0.2%).
    f. The monitor shall be microprocessor based and shall be fully user programmable.
    g. Secondary meters as required by the Riser Diagram shall be Square D PowerLogic PM850 or alternate approved by UH FP&C.
4. Building Automation System (BAS) Interface: Coordinate with building controls vendor to provide interface with BAS. If BAS in not compatible with Modbus provide a BACnet interface to allow the BAS (Building Automation System) to monitor the switchgear's metering.

F. Overcurrent Devices:
1. Switchgear shall contained circuit breakers sized as shown on the contract drawings and as described below:
2. Main and tie protective devices shall be low voltage power circuit breakers. All protective devices shall be UL1066 Listed, designed and tested to ANSI C37 and NEMA SG-3 standards.

3. Circuit breakers shall have a true, two step stored energy mechanism providing quick make and quick break operation. The breaker mechanism shall be capable of being charged after closing the circuit breaker. It shall be possible to discharge the energy in the closing spring without closing the breaker main contacts. Manual charging of stored-energy mechanism and operation of devices shall be accomplished with compartment door closed and latched.
4. Main Breakers: **The breakers shall be provided with RELT (Reduced Energy Let-thru) functionality. This provision shall provide the breaker with the capability of being set to an alternate instantaneous setting including the minimum instantaneous trip setting for the breaker to reduce arc flash energy while in a maintenance mode. The signal to set to minimum setting shall factory wired to a switch on the front of the switchgear or at a remote location as indicated on the drawings. There shall be an indicating lamp to let the operator know that control power is available to operate the RELT system and an indicating lamp or illuminated switch that indicates the settings are in the RELT mode. The signal to indicate the breaker is in the RELT mode shall be in the form of positive feedback from the trip unit and not just an indication that a signal has been sent. The switch to initiate the RELT function shall be provided with padlock capabilities so that the operator can follow standard lockout tag-out procedures. The suggested instantaneous setting for the alternate RELT function shall be included in the coordination study for the project**
5. Low Voltage Power Circuit Breakers - 800 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 of draw out construction for individual removal and ready replacement from front of switchgear. Draw out construction, shall permit breaker to be withdrawn from an engaged (CONNECTED) position, to test position, and to disengaged position. Draw out mechanism shall be mechanically interlocked with circuit breaker's trip mechanism so that breaker must be OPEN before it can be moved into or out of the CONNECTED position. The breaker shall automatically trip open if it is withdrawn while in CLOSED position. A CLOSED breaker shall trip open before it is racked into the engaged position.
    d. Breakers shall be equipped with a solid-state programmer, flux shift trip device, and current sensors to control the breaker operation

under overload and fault conditions. The solid-state electronic programmer shall have the following features and tripping functions.

1) Adjustable current setting. (.5-1.0X in .05 increments)
2) Adjustable long-time delay. (19 bands)
3) Adjustable instantaneous pick-up.(0.5X increments)
4) Adjustable short time delay. (11 constant bands, 3 slopes)
5) Adjustable short time pick-up. (0.5XLT increments)

Where GF is indicated on the drawings or schedules, provide the following:

6) Adjustable ground fault pickup. (0.01 increments)
7) Adjustable ground fault delay. (14 bands, 2 slopes)

e. Breakers shall have a minimum symmetrical interrupting rating of 65,000 amperes, 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.

G. Ground Fault Protection: Where 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 20% of breaker sensor rating to 1200 amperes or breaker trip rating and minimum of .058 sec to .917 sec 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 switchgear manufacturer shall include in the submittal data for the switchgear, the minimum setting of the devices and the recommended setting for normal building operation shall be provided in the coordination study.
3. The ground fault system shall be factory-tested prior to shipment as specified herein:
   a. The switchgear 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.

H. Kirk key interlocks shall be provided between main-tie-main or between two main devices on manually operated throw-over scheme as shown on the one line diagrams.

I. Provide infrared scanning windows in the rear covers of main switchgear sections, including main-tie-main, to facilitate the use of an IR camera for purposes of thermal scanning incoming and outgoing lugs of main circuit breakers. The IR windows shall be an IR “transparent” mesh for indoor NEMA 1 applications or an IR crystal window for outdoor NEMA 3R applications. IR windows shall have a gasketed cover plate secured with tamper-resistant hardware.

PART 3 - EXECUTION

3.01 INSTALLATION OF SWITCHGEAR:

A. General: Install switchgear where shown, in accordance with the manufacturer's written instructions and recognized industry practices to ensure that the switchgear 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 switchgear.

C. Tightness: Torque bus connections and tighten mechanical fasteners.

D. Concrete Pads: Install switchgear on a reinforced concrete housekeeping pad. The housekeeping pad shall extend 3" beyond the housing of the switchgear unless shown otherwise. Switchgear 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.

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

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

3.02 TESTING:

A. Pre-energization Checks: Prior to energization, check switchgear for continuity of circuits and for short circuits.

B. Switchgear Insulation Resistance Test: Each switchgear 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 recommended settings in the coordination study 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 switchgear tested, date and time of test, relative humidity, temperature, and weather conditions.

E. Thermographic Testing: Conduct a thermographic test of the switchgear and their connections using an infrared temperature scanning unit. The test shall be performed by an independent testing laboratory (General Electric, Eaton Electrical Systems and Solutions or Siemens Industrial Service). Connections indicating higher temperature levels than are acceptable shall be tightened or corrected as required to eliminate the condition. Conduct test, using test reporting forms, between 6 and 8 months after beneficial occupancy, but in no case beyond the one year warranty period. Correct unacceptable conditions prior to end of the warranty period.

3.03 IDENTIFICATION:

A. Mimic Bus: Provide a mimic bus on each switchgear to show busing, connections, and devices in single line form on an engraved nameplate securely attached with screws on the front panels of the switchgear. The color shall be white and shall comply with the requirements of Section 26 05 53 - Electrical Identification.

END OF SECTION 26 24 14