SECTION 26 13 00 – Medium-voltage switchgear

1. GENERAL
	* + 1. RELATED DOCUMENTS
				1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
				2. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.
				3. Basic Electrical requirements, Section 26 01 00
				4. 48v DC Battery System, Section 26 33 34
			2. SUMMARY
				1. Work Included:

Provide medium voltage switchgear Work as shown, scheduled, indicated, and as specified. Switchgear and relaying data shall be submitted to the power company for approval.

* + - * 1. Types:

The types of switchgear required for the Project include, but are not limited to, medium voltage metal enclosed power distribution switchgear.

* + - * 1. Provide the control power requirements to size the 48V DC Battery system specified in Section 26 33 24.
			1. REFERENCE STANDARDS
				1. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
				2. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
				3. Products shall be designed, manufactured, tested, and installed in compliance with the following standards:

ANSI C12.1 - Code for Electricity Metering

ANSI C39.1 - Requirements for Electrical Analog Indicating Instruments

ANSI/IEEE C57.13 – Standard Requirements for Instrument Transformers

ANSI/IEEE C37.90.1 – Guide for Surge Withstand Capability Tests

ANSI C37.54 - Conformance Test Procedures for Indoor AC High-Voltage Circuit Breakers Applied as Removable Elements in Metal-Enclosed Switchgear

ANSI C37.55 - Conformance Test Procedures for Medium-Voltage Metal-Clad Assemblies

UL 1449 – Standard for Safety for Surge Protective Devices, 3rd Edition

NFPA 70 – National Electrical Code

* + - 1. QUALITY ASSURANCE
				1. Manufacturers: Provide products complying with these Specifications and produced by one (1) of the following:

Square D Company

Eaton

* + - * 1. NEMA Compliance:

Comply with applicable National Electrical Manufacturer’s Association (NEMA) Standards.

NEMA SG-2 High Voltage Fuses

NEMA SG-4 Alternating Current High Voltage Circuit Breakers

NEMA SG-5 Power Switchgear Assemblies

* + - * 1. UL Labels:

Provide switchgear which has been UL-labeled for service entrance.

* + - 1. SUBMITTALS
				1. Shop Drawing submittals shall include, but not be limited to, the following:

Dimensioned drawings of metal enclosed switchgear showing accurately scaled basic units including, but not necessarily limited to, auxiliary compartments, unit components, combination units, outline dimensions, top & bottom views showing entry and exit spaces for conduits and front & side elevations showing arrangement of all devices.

Total full weight of unit.

Installation procedures.

One-line diagram.

Operation and Maintenance Manuals.

Instrument transformer data

Coordination curves for each type and rating of circuit breaker.

Arc flash calculation to determine the energy/heat available during short circuit conditions.

Schematics and wiring diagrams for metering and controls.

Furnish, upon request, manufacturer’s certification of rating of the basic breaker, switch, and fusing components and the integrated metal enclosure.

Furnish, upon request, manufacturer’s product data of metal enclosed switchgear and all related components.

Dimensioned drawings of metal enclosed switchgear showing accurately scaled basic units including, but not necessarily limited to, auxiliary compartments, unit components and combination units.

* + - 1. DELIVERY, STORAGE and HANDLING
				1. Deliver switchgear in factory-fabricated water resistant wrapping, store and protect in accordance to the recommended practices listed in the manufacture’s Installation and Maintenance Manuals.
				2. Deliver in maximum two section shipping splits. Each shipping split section shall be mounted on shipping skids and wrapped for protection.
				3. Inspect and report concealed damage to carrier within 48 hours of delivery.
				4. Maintain factory-wrapping or provide an additional heavy canvas or plastic cover.
				5. Store switchgear in a clean and dry space. Maintain factory protection or cover with heavy canvas or plastic to keep out dirt, water, construction debris and traffic. Connect 120 vac control power to energize space heater within equipment to prevent condensation.
				6. Handle switchgear in accordance with manufacturer’s written instructions to avoid damage to equipment, installed devices, enclosures and finish.
1. PRODUCTS
	* + 1. GENERAL
				1. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
			2. MATERIALS AND COMPONENTS
				1. General: Provide a factory-assembled, indoor metal-clad switchgear line up for use on a 4160 volt, 3 phase, 3 wire, grounded, 60 Hz system. Switchgear shall have the configuration, ampacity and short circuit bracing shown and shall be 60 kV BIL.

The switchgear shall consist of a main-tie-main incoming group with draw out vacuum breaker main and tie breakers and draw out vacuum breaker feeder devices.

* + - * 1. Stationary Structure:

The switchgear shall consist of breaker/switch compartments and auxiliary compartments assembled to form a rigid self-supporting completely enclosed structure providing painted steel between Sections. Each Section shall be segregated by metal barriers into the following separate compartments:

Overcurrent device

Main bus

Auxiliary Device

Cable

* + - * 1. Enclosure:

Switchgear shall consist of breaker and auxiliary units, as indicated in drawings, bolted together to form a rigid, self-supporting, metal-enclosed structure. Outdoor metal clad switchgear shall be enclosed in a weatherproof enclosure and shall include suitable weatherproof access doors, doors with provision for padlocking; protected ventilation openings as required; interior lighting, utility outlets with protective devices; and equipment heaters with protective devices. In each unit, major primary circuit parts (breaker, buses, transformers) shall be completely enclosed by grounded metal barriers, including a front barrier as part of the circuit breaker. The maximum number of primary interrupting devices per vertical section shall be two.

Switchgear units shall be arranged as shown on attached drawings.

For rigidity during fault conditions all connections to roll-out potential transformer trays and control power transformer trays shall be rigid bus bars insulated to full voltage rating of switchgear assembly.

Circuit breaker compartments shall be designed to house [{5.0}{8.25}{15.0}] KV removable-element circuit breakers. Stationary primary disconnect contacts shall be silver-plated copper. Grounded metal safety shutters shall isolate all primary connections in compartment when breaker is withdrawn from connected position.

Furnish nameplates for each device as indicated in drawings. Nameplates shall be black-white-black lamacoid nameplates with 3/8 inch black lettering secured to the front of the unit by means of oval head, chrome plated brass screws. On breaker units, place nameplate immediately below control switch. There shall be a master nameplate that indicates equipment ratings, manufacturer's name, shop order number and general information.

Caution Signs. Provide caution signs in accordance with the NEC and OSHA requirements.

* + - * 1. Incoming Compartments:

The incoming compartments shall consist of a metal-clad incoming cable compartment associated with the main and tie breaker cubicles, as shown. Incoming cables shall be terminated using stress cone type terminators.

* + - * 1. Breaker Compartments:

Breaker compartments shall be designated to house draw out vacuum circuit breakers. Silver-plated copper stationary contacts shall be provided and safety shutters shall isolate all primary connections in the circuit breaker compartment when the breaker is withdrawn from the connected position. The breaker compartment shall include a mechanism to move the breaker between the operating and disconnect positions. The mechanism shall be designed so that the breaker is self-aligning and rigidly held in the operating position. In the disconnected position, the breaker shall be easily rolled from the compartment.

* + - * 1. Cable Compartment:

The breaker primary disconnecting contacts shall be extended into the cable compartment by means of insulated bushings. The current transformer for overcurrent protection and other relaying functions are to mount on these bushings and be accessible from the front of the unit. Stress cone cable terminators shall be used for incoming and outgoing cable termination. The ground bus shall extend through this compartment for the full length of the switchgear.

* + - * 1. Bus Compartment:

The main bus shall be silver-plated copper, rated as shown based upon design tests and temperature rise per ANSI standards and shall be fully insulated. All bus joints shall be silver-plated, bolted with a minimum of two bolts, and insulated. Busbars shall be braced to withstand the magnetic stresses developed by currents equal to the main device close, carry, and interrupt ratings.

* + - * 1. Ground Bus:

A minimum 1/4 inch X 2 inch copper ground bus shall extend the entire length of the switchgear.

* + - * 1. Finish:

All steel surfaces shall be cleaned, phosphatized, and finished in the manufacturer’s standard gray enamel.

Nameplates shall be per the basic electrical requirements listed in Specification Section 26 01 00.

* + - * 1. Circuit Breakers:

Circuit breakers shall be drawout type and utilize vacuum interrupters. Circuit breakers of equal rating shall be interchangeable. Circuit breakers shall be stored-energy spring charged type, mechanically and electrically trip-free. A handle shall be supplied to manually charge the spring for slow closing of contacts for inspection or adjustment. Circuit breakers shall have a symmetrical interrupting rating of 63kA, nominal MVA rating of 250.

Circuit breakers shall be equipped with secondary disconnecting contacts, which shall automatically engage in the connected position.

Each breaker compartment shall have a breaker rackout device. Using rackout device, a breaker will be self-aligning and will be held rigidly in the operating position. In the disconnect position, breaker shall be easily removable from compartment. Breaker racking shall be accomplished with door closed and latched. Insert handle through a hole in front door to operate rackout device.

An indicating tape shall show breaker position when racking breakers in or out of their connected positions. Each circuit breaker mechanism shall also be positively and solidly grounded the complete length of this travel, utilizing a plated copper ground bar and shoe.

Interlocks shall prevent moving breaker to or from operating position unless main contacts are open. Operating springs shall be discharged automatically when breaker is rolled fully into connected or disconnected position. Rackout device shall have provisions to padlock in connected or disconnected position. When locked in disconnected position, breaker shall be removable from compartment using portable lifting device. Padlock shall not interfere with breaker operation.

Automatic shutters shall cover primary disconnect stabs when breaker is withdrawn to test/disconnect position. Linkages connected to racking mechanism shall positively drive shutters. A stationary barrier shall be located in front of the shutters for additional safety.

Breaker control voltage shall be 48 VDC.

* + - * 1. Instrument Transformers:

Current transformers shall have multi-tap secondary and ratios as shown or required, mechanical ratings equal to the momentary rating of the main circuit breaker, and shall be insulated for the full voltage rating of the switchgear. Relay current transformers shall be located on the line side of the device controlled by the relay.

Potential transformers shall be draw-out type, protected by current limiting fuses, and shall ratios as shown or required.

Secondary control wiring shall be No. 14, extra flexible, stranded, tinned-copper control wire, Type SIS cross-linked polyethylene, rated 600 volts, except for specific circuits requiring larger wire. Crimp-type, un-insulated spring-spade terminals shall be furnished on all wire ends, except for current transformer circuits where non-insulated ring terminals are used. Secondary control wires shall be armored where they pass through primary compartments.

* + - * 1. Relays:

Protective relays shall be provided as specified herein,, scheduled or as shown on the Drawings (designated using ANSI standard designations). Relays shall be solid state type and draw out cases.

* + - * 1. Electronic Metering Devices:

Refer to Section 26 09 13, Power Status and Monitoring System.

* + - * 1. Watthour Meters:

Kilowatt-hour demand meter with dial integrating demand register with electronic pulse initiator as specified herein, scheduled or as shown on the Drawings. Demand interval to be 15 minutes.

* + - * 1. Lightning Arrestors:

Provide distribution class lightning arrestors mounted in the switchgear enclosure and connected to the incoming service leads.

* + - * 1. Interlocks:

Provide kirk-key and electrical interlocks on for the main and tie breakers circuit breakers such that the tie can only be closed when one of the main breakers is opened and the tie must be open for both mains to be closed. Provide one (1) key for each pair of locks. Use auxiliary contacts located on circuit breakers for electrical interlocks.

* + - * 1. Control Wiring:

The switchgear shall be wired with Type SIS # 14 AWG, except where larger size wire is required. The switchgear shall be provided with terminal blocks for outgoing control connections.

* + - * 1. Spare Fuses:

Provide one (1) spare set of fuses for each different type and size of fuse installed.

* + - * 1. Accessories:

Provide one (1) set of standard accessories for testing and maintenance of the switchgear including, but not limited to one each of the following:

Manual stored-energy spring-charging handle.

Hand crank for moving breaker between test and connected positions.

Motorized, 120 volt, portable remote breaker racking unit attachable to one breaker cell at a time. Provide unit with a 30-ft cord to control racking manually from remote location within the room. The racking system shall automatically disconnect the racking motor power supply after the breaker is completely engaged or de-energized without damage to the motor or other equipment, shall be “spin-free” at both ends of the travel with a protective mechanism to avoid damage to the motor or other equipment.

Secondary test coupler for testing breakers while in the test position.

Pulling and turning dolly for breakers.

Test cabinet for electrically testing breakers outside of the cubicle.

Set of test plugs for protective relays when applicable.

* + - 1. factory testing
				1. General:

The switchgear including overcurrent devices, relays, meters, controls and interlocks shall be factory tested to certify proper operation.

* + - 1. overcurrent device configuration:
				1. Main Breakers: The metal clad switchgear for control of main breakers shall include, but not be limited to:

One (1) 4160 volt vacuum power circuit breaker, 1200 amperes continuous 60kV BIL, 250 MVA interrupting capacity, 3 pole, with electrically-operated, stored-energy mechanism.

One (1) set of insulated bus, 3 phase, 3 wire, 1200 amperes.

Three (3) digital solid state 50/51 very inverse time phase overcurrent relays.

Three (3) single-ratio secondary current transformers with 1200:5 ratio.

One (1) digital solid state 51N time delay ground fault relay.

One (1) ground sensor current transformer with 50:5 ratio.

One (1) breaker control switch.

Two (2) indicating lamps, red breaker open/green breaker closed.

One (1) breaker closing 2 pole pull-out type fuse block.

One (1) breaker tripping 2 pole pull-out type fuse block.

Provisions for stress cone power conductor terminations as shown on the Drawings.

One (1) current test block.

One (1) voltage test block.

One (1) breaker disagreement indicating lamp.

Three (3) surge arresters.

One (1) electronic metering device.

One (1) watt-hour demand meter.

One (1) kirk key interlock.

* + - * 1. Tie Breaker: The metal clad switchgear for control of the tie breaker shall include, but not be limited to:

One (1) 4160 volt vacuum power circuit breaker, 1200 amperes continuous 60kV BIL, 250 MVA interrupting capacity, 3 pole, with electrically-operated, stored- energy mechanism.

One (1) set of insulated bus, 3 phase, 3 wire, 1200 amperes.

Three (3) digital solid state 87B high speed bus differential relays.

Three (3) single-ratio secondary current transformers with 1200:5 ratio.

One (1) breaker closing 2 pole pull-out type fuse block.

One (1) breaker tripping 2 pole pull-out type fuse block.

One (1) current test block.

One (1) voltage test block.

One (1) breaker disagreement indicating lamp.

Two (2) kirk key interlocks.

* + - * 1. General Purpose Feeder (GPF) Breakers: The metal clad switchgear for control of feeder circuit breakers shall include, but not be limited to:

One (1) 4160 volt vacuum power circuit breaker, 1200 amperes continuous 60 kV BIL, 250 MVA interrupting capacity, 3 pole, with electrically-operated, stored- energy mechanism.

One (1) set of insulated bus, 3 phase, 3 wire, 1200 amperes.

Three (3) digital solid state 50/51 very inverse time phase overcurrent relays.

Three (3) single-ratio secondary current transformers with 600:5 ratio.

One (1) digital sold state 51N time delay ground fault relay.

One (1) ground sensor current transformer with 50:5 ratio.

One (1) breaker control switch.

Two (2) indicating lamps, red breaker open/green breaker closed.

One (1) breaker 2 pole pull-out type fuse block.

One (1) breaker tripping 2 pole pull-out type fuse block.

Provisions for stress cone power conductor terminations as shown on the Drawings.

One (1) current test block.

One (1) voltage test block.

One (1) breaker disagreement indicating lamp.

One (1) electronic metering device.

One (1) watt-hour demand meter.

1. EXECUTION
	* + 1. INSTALLATION
				1. General:

Install switchgear where shown, in accordance with the manufacturer’s written instructions and recognized industry practices, to ensure that the switchgear complies with the requirements and serves the intended purposes.

Install communication with BAS System per construction documentation.

* + - * 1. Standards:

Comply with the requirements of NEMA and NEC standards and applicable portions of NECA’s “Standard of Installation”, for installation of switchgear.

* + - * 1. Tightness:

Torgue bus connections and tighten mechanical fasteners.

* + - * 1. Fuses:

Install fuses, of the ratings shown, in each load interrupter switch.

* + - * 1. Concrete Pads:

Install switchgear on a reinforced concrete housekeeping pad. The housekeeping pad shall extend 3 inches beyond the housing of the switchgear unless shown otherwise. 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. Pad shall be configured for use of a portable breaker lifting device.

* + - * 1. Adjust:

Adjust operating mechanisms for free mechanical movement.

Set breakers and relays per construction documents.

* + - 1. TESTING
				1. Pre-energization Checks:

Prior to energization, check switchgear for continuity of circuits and for short circuits.

* + - * 1. Switchgear Testing : Switchgear testing shall be performed to the NETA standards as follows:

NETA Standard 6 Power System Studies

NETA Standard 7.6.2.1 Medium Voltage Air Circuit Breakers

NETA Standard 7.9 Protective relays

NETA standard 7.10 Instrument Transformers

NETA Standard 7.11 Metering

NETA standard 7.13 Grounding System

NETA Standard 7.14 Ground Fault Protection

* + - * 1. Submittals:

Contractor shall furnish all instruments and personnel required for tests.

Submit four (4) 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.

END OF SECTION 26 13 00