SECTION 16316

MEDIUM VOLTAGE METAL CLAD SWITCHGEAR

PART 1 GENERAL

1.1 SUMMARY

A. Scope
1. Furnish and deliver to the Project Site 15KV outdoor and 5KV indoor, metal clad, dead front, vacuum break circuit breaker switchgear assemblies, arranged as indicated on the DRAWINGS. The maximum size of any shipping section shall not exceed four compartments of switchgear. Each switchgear assembly shall be designed and constructed to permit additional feeder circuit breaker enclosures to be added in the future, and shall be complete with all appurtenances and accessories.
2. 120 Volt control power for 5KV indoor switchgear and 120 Volt control and heater power for 15KV outdoor switchgear shall be provided by the OWNER.
3. Provide, shipped loose, all necessary splice plates, connectors, cable, hardware, etc., required for field interconnections of switchgear sections.
4. Furnish the services of a qualified service engineer at the Project Site for not less than three consecutive days of service as defined under Article “INSTALLATION AND CHECKOUT.
5. Overcurrent and directional overcurrent relays have been specified with time current characteristics and with current tap units which are intended to be coordinated with devices being installed both upstream and downstream of the switchgear. If at a later time it should be determined that a different time current characteristic or tap range is more desirable, state in the proposal the latest date at which a change of this nature can be accomplished without affecting either the delivery schedule or the price.

B. Description Of Service
1. Switchgear. Outdoor switchgear suitable for use on a 13.8 KV, 3 phase, 3 wire, 60 hertz, low resistance grounded system capable of delivering 40,000 RMS symmetrical amperes maximum fault current. Indoor switchgear suitable for use on a 4.16 KV 3 phase, 3 wire, 60 hertz, low resistance grounded system capable of delivering 40,000 RMS symmetrical amperes maximum fault current.

C. Reference Specifications
1. Electrical General Provisions - SECTION 16010.
2. Basic Materials and Methods - SECTION 16050.

1.2 RELATED WORK SPECIFIED UNDER OTHER SECTIONS

1.3 QUALITY CONTROL

A. Standard Of Quality
1. Furnish equipment meeting all applicable requirements of IEEE, and UL Codes and Standards.

2. Codes and Standards. Conform to the following:
   a. American National Standards Institute (ANSI)

1)	C37.04	AC Power Circuit Breaker Rating Structure
2)	C37.06	Preferred Ratings of Power Circuit Breakers
3)	C37.09	Test Procedure for Power Circuit Breakers
4)	C37.010	Application Guide for Power Circuit Breakers
5)	C37.11	Power Circuit Breaker Control Requirements
6)	C37.20	Switchgear Assemblies and Metal-Enclosed Bus
7)	C37.90	Standard Relays and Relay Systems Associated with Electric Power Apparatus
8)	C37.100	Definitions for Power Switchgear

   b. National Electrical Manufacturers Association (NEMA)

1)	SG-2	High Voltage Fuses
2)	SG-4	Power Circuit Breakers
3)	SG-5	Power Switchgear Assemblies

B. Installation And Checkout
   1. Provide the services of a fully qualified field engineer at the site, as directed by the ARCHITECT-ENGINEER, to provide guidance during the installation of the switchgear, to check out the work of the installing contractor, to instruct the OWNER in the care and operation of the equipment, and to be present while the relays are being calibrated and tested.
   2. The field engineer will be required to inspect the installation, make whatever adjustments he deems necessary to assure that the switchgear is ready to be energized and put into service, and shall be authorized to sign the following statements in behalf of the manufacturer:
      a. “The undersigned certifies that, as a responsible agent of his organization, he has inspected the equipment, and that it is ready to be placed in service.
      b. “The equipment has been field inspected, adjusted per the manufacturer’s instruction booklets, where necessary, and complies with the approved shop drawings.”

C. Source Quality Control
   1. After completion of fabrication, the assembled switchgear shall be thoroughly factory-tested for function and compliance with the SPECIFICATIONS. Certify to the ARCHITECT-ENGINEER that the switchgear has been so tested.

1.4 SUBMITTALS

A. Furnish submittals for items that are identified in this SECTION by a different typeface and a bracketed code (e.g., *Item [L]*). Refer to SECTION 01340 for definition of codes for types of submittals and the administrative requirements governing submittal procedure.

B. *Assembled switchgear [B,D,P]:* Submit certified outline drawings showing overall dimensions of the switchgear,. Drawings shall indicate shipping units and recommended front, rear, side and top clearances. Indicate estimated weight of each shipping section and shipping weight of circuit breaker draw-out units, etc. Show mounting or anchor bolts required, space available at top and bottom for entrance of medium voltage cables and conduit and for low voltage control

cable and conduit. Provide a complete Bill of Material (Device Summary) for all items incorporated in the assembled switchgear.

C. *Single Line and Wiring Diagrams [D]:* Show main bus, circuit breakers, all current and potential transformers, meters, instruments, relays, control and selector switches, and associated equipment. Provide complete connection and interconnection wiring diagrams for switchgear and ancillary units.

D. *Test Reports [T]:* Submit manufacturer's factory tests. Submit copies of previous tests on essentially identical equipment under actual conditions, not simulated, for momentary test on bus, and momentary and interrupting tests of breakers.

E. *Guarantee [G]:* Warrant that:
   1. The equipment and auxiliaries, meet the operating conditions, capacity and performance specified, and will remain in serviceable working condition, for a period of one year from date of final completion and acceptance of the system by the OWNER; and that
   2. If the equipment, or auxiliaries, fail, or fail to meet any of the specified requirements, the equipment or auxiliaries shall promptly be reworked or replaced as necessary to comply with the CONTRACT requirements, all at no cost to the OWNER, and the guarantee shall be extended for one year from date of acceptance of the reworked or replaced equipment or auxiliary.

1.5 MAINTENANCE DATA AND OPERATING INSTRUCTIONS

A. Furnish, per SECTION 01730, manufacturer's general instructions for operation and maintenance of equipment, and parts list with list of recommended spare parts.

PART 2 PRODUCTS

2.1 FABRICATION AND MANUFACTURE

A. Manufacturers
   1. General Electric.
   2. Siemens Energy & Automation.
   3. Square D.
   4. Eaton/Cutler Hammer.

B. Switchgear
   1. Outdoor switchgear shall be weather proof enclosed metal clad, dead front, one-high construction. Indoor switchgear shall be totally enclosed metal clad, dead front one-high and two high construction as indicated on the drawings. Provide transition section for bus connection to medium voltage metal enclosed fused switch switchgear (see drawings and specification section 16318. Enclosures shall be constructed of not less than No. 11 gage steel, formed and framed for rigidity. Front panels and framework shall be of welded construction with all burrs ground smooth. Front panels shall be of hinged construction with locking handles. Rear and side panels shall be removable, bolted in place. Hinged

rear panels are acceptable but will require lockable handles and captive bolts for fastening.

2. Housing and main busing shall be arranged as indicated on the DRAWINGS. The switchgear shall be designed and constructed to permit additional feeder circuit breaker enclosures to be added in the future.
3. Auxiliary compartments where required for bus transition, potential transformer draw-out carriages, and associated hardware, shall be of the same height and depth as the circuit breaker compartments.
4. Circuit breaker compartments shall be for horizontal draw-out type circuit breaker elements. Compartments shall include automatic safety shutters which will block access to the stationary circuit breaker stabs unless the drawout element is locked into the operating position. The mechanism shall give positive indication of the breaker position, i.e., engaged, test and disconnected.
5. All compartments shall have interior compartmentation to provide full isolation for:
   a. Circuit breaker elements.
   b. Main power bus and current transformers.
   c. Cable termination compartments.
   d. Potential transformers.
   e. Low voltage relaying, metering, fusing and control.
6. Cable termination compartment at the rear of each incoming line compartment shall be full height and shall provide adequate space for stress cone termination in outdoor and indoor switchgear for cables as indicated on one line diagram on Drawing E-601. Design shall be such that feeder cables can enter from above or from below as indicated on the DRAWINGS. Incoming main cables will enter from above.
7. All enclosures shall be thoroughly cleaned and degreased after fabrication, bonderized and primed with zinc chromate. Finish shall be gray synthetic lacquer or enamel, per ANSI Standard No. 61 (match existing switchgear).

C. Circuit Breakers
1. 15 KV Incoming Line, Bus Tie and Feeder Circuit Breakers shall have the following characteristics:
   a. Type. 3 pole, vacuum circuit breaker
   b. Continuous current rating: 1200 amperes (Feeders. 1200 amperes)
   c. Voltage rating, operating: 13.8 KV, 60 hertz
      Maximum: 15 KV
      B.I.L.: 95 KV
   d. Nominal Interrupting Rating: 500 MVA
   e. Interrupting Capability: 28,000 RMS amperes, at 13.8 KV
   f. Close and Latch Capability: 37,000 RMS amperes, at 13.8 KV
   g. Interrupting Time: 5 cycles
   h. Breaker Control and Operation: 120 Volts, A.C.
2. 5KV Incoming Line, Bus Tie and Feeder Circuit Breakers shall have the following characteristics:
   a. Type. 3 pole, vacuum circuit breaker
   b. Continuous current rating: 1200 amperes (Feeders. 1200 amperes)
   c. Voltage rating, operating: 4.16 KV, 60 hertz

	Maximum:	5 KV
	B.I.L.:	60 KV
d.	Nominal Interrupting Rating:	250 MVA
e.	Interrupting Capability:	29,000 RMS amperes, at 4.16 KV
f.	Close and Latch Capability:	58,000 RMS amperes, at 4.16 KV
g.	Interrupting Time:	5 cycles
h.	Breaker Control and Operation:	120 Volts, A.C.

3. All circuit breaker operating mechanisms shall be of the stored energy type and shall be mechanically and electrically trip-free. Stored energy springs shall be charged by an electric motor mechanism operating from the control power (120 volts, A.C.). Interlocks shall be provided to prevent either engaging or disengaging the circuit breaker unless it is in the “tripped” position. Operating mechanisms shall be arranged so that all springs are discharged before the breaker can be racked into the “disconnected” position.
4. In addition to any auxiliary contacts required for circuit breaker control, provide at least four isolated, convertible auxiliary contacts suitable for low-current monitoring and wired to accessible terminal blocks for use by the OWNER.

D. Bus Work

1. Buses shall be of hard drawn copper bars. Cross sectional area of bus shall be such that current density will not exceed 1000 amperes per square inch. Contact surfaces shall be designed so that the current density across contact surfaces will not exceed 200 amperes per square inch. All contact surfaces shall be silver plated. All bolts, nuts, washers, etc., required for assembly of buses shall be plated to resist corrosion.
2. NEMA standard phase rotation shall be maintained throughout.
3. The continuous current rating of the main bus, for its entire length, shall be 1200 amperes. Bus connections to the incoming line circuit breaker, including extensions from the line side of the incoming line circuit breaker into the cable entrance compartment shall also have a continuous rating of 1200 amperes.
4. Bus taps to the feeder circuit breakers and extensions from the load side of these circuit breakers into the cable termination compartments shall have a continuous rating of 1200 amperes.
5. All bus bars, including taps and extensions shall be adequately braced and supported to withstand short circuit currents up to and including the full close and latch capability of the circuit breakers.
6. Bus support insulators shall be porcelain or cast cycloaliphatic plastic material. “Glastic” (glass-polyester) insulators are not acceptable.
7. Should it be necessary to split the main bus at shipping section breaks, provide the necessary splice plates and hardware for field installation. The main bus shall be drilled and silver plated at the ends to permit extension into future feeder circuit breaker compartments.
8. Bus bars, including taps and extensions shall be individually insulated with an epoxy insulation coating applied by a fluidized bed process, or an equivalent coating. Insulation shall be of flame resisting, self extinguishing, non-hygroscopic, non-tracking material. Factory joints shall be insulated by tape or molded insulating covers. Manufacturer shall furnish an adequate supply of insulating material for field insulation of splice plates at any shipping breaks.

9. At incoming line and feeder circuit breakers the upper terminals shall connect to the main bus, the rear or lower terminals shall connect to bus extensions into the cable termination compartments.
10. Bus extensions from the main circuit breaker into the cable termination compartment shall terminate in pressure type cable connectors. Bus extension from each of the feeder circuit breakers into the cable termination compartments shall terminate in pressure type cable connector. Each cable connector shall accommodate a stranded copper conductor as indicated on one line diagram on Drawing E-601.
11. Provide a 2 inch by 1/4 inch copper ground bar running the entire length of each switchgear assembly. Ground bus shall be located near the bottom rear of the cable termination compartments, to be accessible when the rear panels of the enclosure are removed. Bond the ground bus to each enclosure structure and extend the bus into each circuit breaker compartment to engage with the grounding shoe on the circuit breaker draw-out mechanism. In each main cable termination compartment the ground bus shall be provided with one clamp pressure type connector suitable for terminating a 250 Kcmil stranded copper ground conductor. In each feeder cable termination compartment the ground bus shall be provided with one clamp pressure type connector suitable for terminating a No. 4/0 AWG stranded copper ground conductor.
12. Vacuum breakers shall be provided with surge arresters for the suppression of switching surges. Surge arresters shall be of the zinc oxide type.

E. Lightning Arresters
1. Provide lightning arresters for each incoming line. A total of three arresters are required for each line, one per phase. Lightning arresters shall be connected immediately ahead of the line side terminals of the Incoming Line circuit breaker, and may be physically mounted in the cable termination compartment. All connections to lightning arresters shall be insulated.
2. Lightning arresters shall be of the station type.
   a. ABB Type IMX or Type Exlim Q
   b. General Electric “Tranqell XE”
   c. Hubbell/The Ohio Brass Company “Dynavar” Type VL

F. Microprocessor-based trip and metering unit.
1. Provide a microprocessor-based trip unit as part of an integrated power protection, monitoring, and control system. This unit shall provide long time over current tripping, short time over current tripping with i^2t function. In addition provide the following features:
   a. Protective functions for undervoltage and power reversal.
   b. Metering functions: The following real time data for each breaker shall be available for display:
      1) Current for each phase.
      2) RMS phase to phase voltage for each phase.
      3) Energy reading (kWh). Based on real power and time.
      4) Present demand load (kW).
      5) Peak demand load (kW).
      6) Reactive power (kvar).
      7) Real power (kW).
      8) Total power (kva).

9) Power factor.
10) Percent ampere peak capacity.
11) Frequency of the line voltage.

c. Event reporting: The following data shall be provided:
1) Type of event: Long time overcurrent trip, short time overcurrent trip, instantaneous trip, ground fault trip, other protective trips, and abnormal. Conditions.
2) Current at time of event.
3) Date and time of event.
4) Identification of breaker.
5) Number of the event in the order recorded.

d. Status reporting: The following data shall be provided:
1) Breaker status: The information shall include the breaker position over current status, protective-functions status and result of continuous self-diagnostic breaker electronic check.

e. Communication link: The remote communication cable shall be tied into the Brookhaven monitoring system. Field verify tie-in point with Brookhaven and electrical contractor to provide gateway or as required, if required, to tie the two systems together.

G. Circuit Breaker Control Switches
1. Circuit breaker control switches shall be of the rotary cam operated type with spring return and pistol-grip handles. A red indicating light shall be provided, wired to monitor the trip circuit and to indicate “breaker closed” status. A green indicating light shall be provided, wired to indicate “breaker open” status.
a. Electroswitch Type W-2.
b. General Electric Type SB-1.
2. Indicating lights shall be:
a. Eaton/Cutler Hammer Type EZC.
b. General Electric Type ET-16.

H. Switchboard Wiring
1. Do all control wiring within the switchgear with single conductor, Type SIS, flexible stranded copper, tinned wire, with insulation for 600 volts working and 4000 volts test, rated 90 degC for switchboard wiring.
2. Terminate all control and switchboard wiring with tinned ring tongue, solderless compression type lugs.
3. Terminal blocks shall be molded barrier type, rated 30 amperes, 600 volts, with washer head binding screws and white marking strips.
4. Make connections between hinged and stationary panels with terminal blocks and extra flexible wire having the same insulation as the panel wiring and secure wire between terminal blocks with wire cleats to prevent movement at the terminal blocks.
5. Connect all current transformer secondary leads to accessible short circuiting terminal blocks with provisions for retention of the shorting devices.
6. Provide plug-in terminal blocks for all conductors to be continued across all shipping splits.
7. Provide wire markers at each end of all control wiring conductors.

I. Nameplates
   1. Provide engraved, laminated phenolic nameplates, white letters on a black background, to identify each compartment. Two nameplates are required for each compartment, one to be mounted on the front door, the other on the rear cover. Nameplates shall be approximately 2 inch by 4 inch with 1/2 inch high lettering as indicated on the attached DRAWINGS.
   2. On door mounted devices furnish smaller engraved laminated phenolic nameplates to identify devices. Separate nameplates may be omitted where the device nameplate itself clearly indicates its function.
   3. On the rear cover of each compartment housing lightning arresters provide a 6 inches by 8 inch nameplate engraved with 3/4 inch high white letters on a red background: “DANGER - HIGH VOLTAGE LIGHTNING ARRESTERS ARE ALIVE UNLESS UTILITY LINE IS DE-ENERGIZED”.
   4. Terminal strips, fuse blocks, relays and other devices mounted behind enclosure front doors shall be identified with the wiring or device symbol on the wiring diagrams and schematics for the gear. Identification may be by symbols stenciled adjacent to the device, or by engraved nameplates.

J. Portable Breaker Lift
   1. Provide a portable breaker lift for handling a breaker during installation or during removal for inspection or maintenance.
   2. The lift is to be equipped with locking devices on the lifting forks to lock the breaker in place when being transported.

PART 3 EXECUTION

3.1 TESTING

A. Perform factory tests as necessary to demonstrate conformance with the specified requirements. Notify the ARCHITECT-ENGINEER two weeks in advance of testing to be performed so that the ARCHITECT-ENGINEER may have the option to witness testing.

B. As a minimum perform the following tests:
   1. On switchgear assembly:
      a. Power frequency dielectric tests
      b. Mechanical operation test
      c. Grounding instrument transformer case tests
      d. Electrical operation and control wiring tests
      e. Control wiring insulation test
      f. Polarity verification
      g. Sequence tests
   2. On vacuum circuit breakers:
      a. Nameplate check
      b. Control circuit and wiring check tests
      c. Mechanical operations test
      d. Timing test
      e. Conductivity of Current Path Test

f. Low frequency withstand voltage test

3.2 DELIVERY

A. Upon successful completion of tests, deliver the units to the Project Site.

3.3 INSTALLATION

A. Assemble equipment; connect; inspect; test; adjust as required; set protective relays, timers and other devices; determine that equipment operates as specified; and, certify that the switchgear is ready to be placed into service.
   1. Perform tests as specified in SECTION 16999.

B. Upon demonstration that switchgear is ready to be placed into service, place the system into service.

END OF SECTION

Revision History	
Date	**Rev. No.**
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