SECTION 16312

LOAD CENTER UNIT SUBSTATION-DOUBLE ENDED

PART 1 GENERAL

1.1 SUMMARY

A. Scope
1. Provide 1 Load Center Unit Substations, double-ended, indoor type, metal-enclosed construction, for 4,160 volt, three phase, three wire, 60 hertz service, consisting of two incoming line sections, two transformers, and a low voltage drawout air circuit breaker switchgear section, arranged as indicated on the DRAWINGS.

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

1.2 RELATED WORK SPECIFIED UNDER OTHER SECTIONS

1.3 QUALITY ASSURANCE

A. Source Quality Control
1. Construction, Rating and Tests. Comply with the latest requirements of ANSI, IEEE and NEMA Standards.
2. Perform the following factory tests on the equipment furnished:
a. Transformer:
1) Resistance measurement, ratio, polarity and phase relation, excitation loss, excitation current, impedance and load loss, insulation and temperature tests per latest ANSI C57.12.00.
2) Noise level tests per NEMA Standard TR-27.
b. Low Voltage Switchgear:
1) Production tests per latest ANSI Standard C37.13 - 20 - 5.3.
2) Proof of ability to withstand specified symmetrical amperes.
c. Low Voltage Breakers:
1) Complete production tests per latest ANSI Standard C37.13 - 8.3.
2) Proof of ability to pass latest ANSI Standard C37.13 - 8.2.5 (Short Circuit Interrupting Test).
3) Proof of ability to pass latest ANSI Standard C37.13 - 8.2.4 (Short Time Current Test).
3. Do not perform transformer temperature tests, momentary tests on bus, and momentary and interrupting tests on breakers where such tests have been performed on essentially identical equipment under actual conditions, not simulated, and test data is available.

B. Installation And Checkout
1. Provide the services of a fully qualified field engineer at the site, as may be required by the OWNER’S REPRESENTATIVE, to provide guidance during the installation of the

switchgear, to check out the work of the installing contractor, to instruct the OWNER'S REPRESENTATIVE in the care and operation of the equipment, and to be present while the relays are being calibrated and tested by the OWNER'S REPRESENTATIVE.

2. The field engineer will be required to inspect the installation, make whatever adjustments he deems necessary to assure that the substation is ready to be energized and put into service, and shall be authorized to sign the following statement in behalf of the Supplier:

"The undersigned certifies that, as a responsible agent of his organization, he has inspected the equipment, and that is ready to be placed in service.

"The equipment has been field inspected, adjusted per the manufacturer's instruction booklets, where necessary, and complies with the approved shop drawings."

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 [D]*). Refer to SECTION 01340 for definition of codes for types of submittals and the administrative requirements governing submittal procedure. Additional submittal requirements pertaining to this SECTION are specified herein under this Article.

B. *Shop Drawings [D,P]:* Submit manufacturer's certified prints showing assembly of units, outline dimensions and weights, shipping lengths, location of conduits, wiring diagrams, installation drawings, rigging instructions, and a complete bill of material, for each substation. Coordinate incoming line, transformer and 480V switchgear on the same submittal.

C. *Test Reports [T]:* On all factory tests. Submit certified test reports of previous tests on essentially identical equipment under actual conditions, not simulated, for transformer temperature test, momentary test on bus, and momentary and interrupting tests on breakers.

D. *Guarantee [G]* the unit to meet the operating conditions, capacity and performance conditions as specified and to remain serviceable for two years after project acceptance. If either the unit or accessories fail to meet operating requirements or if failure of any part occurs during the guarantee period, rework or replace the affected items promptly to meet the CONTRACT requirements at no cost to the OWNER.

1.5 MAINTENANCE DATA AND OPERATING INSTRUCTIONS

A. Furnish, per SECTION 01730, operating and maintenance manuals for instructions for operation and maintenance of equipment and list of recommended spare parts.

1.6 ACCESSORIES

A. Furnish one complete set of special tools and accessories required for the operation and maintenance of the unit substation equipment. Include:
   1. Rackout handle for breakers.
   2. Integral circuit breaker lifting and handling device, hoist type, capable of handling all sizes of breakers in the substation, as a permanent part of each switchgear structure.

1.7 PRODUCT DELIVERY AND HANDLING

A. Coordination
   1. The manufacturer shall furnish to the Contractor receiving and installing the equipment, all information relative to weights, shipping, sections, parts, assemblies and physical dimensions of all equipment. The manufacturer shall notify the OWNER'S REPRESENTATIVE of delivery one (1) week in advance of shipment.

B. Disassembly and Shipment
   1. Upon completion and assembly of the equipment specified herein, if found necessary for shipping and/or installation purposes to disassemble, all parts shall be match-marked to facilitate erection in the field. The substation shall be shipped in Sections which will pass through an 8' x 10' floor hatch (or door) opening. All units shall be suitably braced and packed for shipping to prevent breakage or distortion while in transit.
   2. All crates, boxes and cartons shall be clearly marked in order to immediately identify the equipment. Shipping invoices shall show the crate, box or carton identification number.

PART 2 PRODUCTS

2.1 FABRICATION AND MANUFACTURE

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

B. Incoming Line Air Terminal Compartment
   1. Incoming Line Air Terminal Compartment: Each consisting of a metal enclosed compartment on the primary terminal side of the transformer and shall include means for supporting and terminating the incoming power cables.
   2. Provide adequate space for the makeup and bracing of stress cones. Equip incoming line terminals with solderless compression type lugs, manufacturer's standard, for cable size indicated. Provide bolted removable plates for access to the compartment.
   3. Cable will enter from above.

C. Transformer Sections (Dry Type)
   1. Transformer Enclosure: Fabricated steel framework with sheet steel bolted removable panels connected to switchgear on one end and the incoming line section on the other end. Provide base construction suitable for using rollers or skidding in any direction. Provide suitable insulating barrier at the secondary bus entrance to prevent passage of ionized gases or rodents between the low voltage switchgear enclosure and the transformer enclosure.
   2. Louvers: Provide adequate louvers to insure proper cooling.
   3. Provide vibration isolation between the core and coil support system and the base of the transformer case to reduce the transmission of vibration to the base and the external

enclosure. The vibration isolators shall be a minimum 1” thick, 40 durometer elastomer pads, complete with anchor bolts and vibration isolation washers, to provide a vibration isolation efficiency of a minimum of 85%. Connect transformer bus to the switchgear bus with flexible connections to minimize vibration transmission to the switchgear.

4. Transformer noise levels shall not exceed the values established in NEMA Standards publication No. TR-1.
5. Transformer Rating: 2,500 KVA, three phase, 60 hertz, 4,160 volt delta primary, 480/277 volt wye secondary, with primary voltage winding BIL of 60 KV minimum. Bring the midpoint (wye) connection of the transformer secondary out insulated as a full capacity bus, along with the three phase buses, and bolt the midpoint to the neutral bus in the switchgear.
6. Transformer: Dry-type, air-cooled, 220 degC temperature class insulation system, 150 degC rise above an ambient air temperature of 30 degC average (40 degC maximum) for any 24 hour period at full load continuous operation on any tap.
7. Impedance: 5.75% on a 2,500 KVA base with NEMA Standard 7-1/2% tolerance.
8. Fan Cooling: Provide all devices and wiring for fan cooling to increase the self-cooled rating to 133%. Provide a 480/120 volt, single phase transformer connected on the line side of the transformer main secondary breaker through current limiting fuses for service to fans and controls.
9. Thermal Relay: Provide a thermal relay detecting the temperature of the cooling air discharging from the top of the windings. Two contacts on the thermal relay shall close when the transformer temperature exceeds that of the natural draft rating. Wire one thermal relay contact to a suitable terminal box for the OWNER’S alarm tie-in. Use the other contact to start the fans.
10. Taps: Provide four full capacity 2-1/2% taps, two above and two below rated voltage in the high voltage winding. Bring out taps to a suitable tap changing terminal board accessible by removing bolted-on covers, for tap changing with transformer de-energized.
11. Insulating Barriers: Provide insulating barriers between coils.

D. Switchgear Section
1. Switchgear Assembly: Consisting of one transformer main secondary breaker, feeder breaker positions, and spaces fully equipped to receive future feeder breaker units.
2. Transformer Main Secondary Breaker:
   a. Breaker: Electrically operated, drawout type, three pole, single throw, 600 volt, 60 hertz, 4000 ampere frame, 65,000 RMS symmetrical ampere interrupting rating at 480 volts, of ampere trip rating as indicated, air circuit breaker.
   b. Equip breaker with an electrically operated stored energy type of mechanism for quick-make closing and with a field adjustable solid state selective trip device providing long time overcurrent tripping, short time overcurrent tripping with i^2t function, and ground fault protection, also with i^2t function, complete with arc quenchers, interpole barriers, position indicator, charge/close/open push-buttons and manual override feature, 120 volt AC shunt trip coil, auxiliary switch for remote signaling and manual operating handle.

c. 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 and ground fault protection, also with i^2t function. In addition provide the following features:
   1) Protective functions for undervoltage, voltage unbalance, current unbalance and power reversal.
   2) Metering functions: The following real time data for each breaker shall be available for display:
      a) Current for each phase.
      b) RMS phase to neutral voltage for each phase.
      c) RMS phase to phase voltage for each phase.
      d) Energy reading (kWh). Based on real power and time.
      e) Present demand load (kW).
      f) Peak demand load (kW).
      g) Reactive power (kvar).
      h) Real power (kW).
      i) Total power (kva) for each phase.
      j) Power factor for each phase.
      k) Percent ampere peak capacity.
      l) Frequency of the line voltage for each phase.
   3) Event reporting: The following data shall be provided:
      a) Type of event: Long time overcurrent trip, short time overcurrent trip, instantaneous trip, ground fault trip, other protective trips, and abnormal conditions.
      b) Current at time of event.
      c) Date and time of event.
      d) Identification of breaker.
      e) Number of the event in the order recorded.
   4) Status reporting: The following data shall be provided:
      a) Breaker status: The information shall include the breaker position over current status, protective-functions status and result of continuous self-diagnostic breaker electronic check.

d. Provide an interlock arrangement that will prevent breaker withdrawal from or return to the operating position with main contacts closed, as well as an interlock to prevent closure of the breaker in any position except test or normal.

e. Equip each transformer main secondary breaker with a key interlock complementary to the one on the tie breaker.

f. Provide means for padlocking the breaker in the test and withdrawn positions such that the breaker cannot be moved from the position in which it is padlocked.

3. Switchgear Accessories:
   a. Two control power transformers, rated 480/120 volts complete with primary current limiting fuses for breaker tripping and fan power. Equip breaker compartment with separate protection for the trip circuit. Provide an automatic transfer of control power from a failed source to the remaining available source.
   b. Provide an integrated power protection, monitoring, and control system having overload and short circuit protection, protective relaying, metering, event reporting, breaker status reporting, and a remote communications link with discrete input monitoring capabilities for the 480 or 480Y/277 volt metal-enclosed low-voltage

power circuit breaker distribution switchgear. Each switchgear section shall be provided with a monitoring unit which shall communicate with every circuit breaker trip device and every instrument transformer in the section. Provide an AC control power source for monitoring and communication devices in the section. Provide a non-volatile memory for data storage. Provide setup value editing capabilities in the monitoring unit.

c. The monitoring unit shall be mounted in a compartment located above the main breaker. The unit shall have a keypad and a digital display. Provide local graphic data viewing capability which includes currents, voltages, real power, and event logs. The keypad shall function to set and modify system parameters.

d. The remote communication link shall include an RS232 or RS485 data communications port. The link between the monitoring unit and the Brookhaven management system shall be field verified and a gateway, as required, shall be provided under the CONTRACT to tie the two systems together.

4. Feeder Breakers:

a. Breakers: Manually operated, drawout type, single throw, 600 volt, 60 hertz, 800, 1600 ampere frame, 65,000 RMS symmetrical ampere interrupting rating at 480 volts, of ampere trip rating as indicated, air circuit breaker.

b. Equip breakers with a manually operated stored energy type mechanism for quick-make closing and with a field adjustable solid state selective trip device, providing long time overcurrent tripping, short time over current tripping with i^2t function, instantaneous short circuit tripping, and ground fault protection, also with i^2t function, complete with arc quenchers, interpole barriers, position indicator, manual trip button, manual operating handle and auxiliary switch for remote signaling.

c. Provide a microprocessor-based trip unit as described for the Transformer Main Secondary Breaker. Include instantaneous short circuit tripping.

d. Provide an interlock arrangement that will prevent breaker withdrawal from or return to the operating position with main contacts closed, as well as an interlock to prevent closure of the breaker in any position except test or normal.

e. Provide means for padlocking the breaker in the test and withdrawn positions such that the breaker cannot be moved from the position in which it is padlocked.

f. Equip all feeder breaker positions with solderless compression type lugs, manufacturer's standard, for cable sizes indicated. Cable will enter the switchgear from above or below.

g. Equip spare feeder breaker positions with breakers and with all features identical to feeder breakers.

h. Equip all future feeder breaker positions with all features identical to feeder breakers less the breaker drawout element.

5. Tie Breaker: 4000 ampere frame with the same features as described for transformer main secondary breakers. Two transformer main secondary breakers and the tie breaker shall be key interlocked so that not more than two of the three breakers can be closed at one time.

6. Ground Fault Protection Note: All ground fault protection shall be suitable for 4 wire service.

E. General Features

1. Bus: Make up all bus of high conductivity bar copper or aluminum, and mount on rugged insulating supports. Provide bus with continuous and short circuit current ratings equal to those of the transformer main secondary breaker.
2. The unit substation manufacturer shall be responsible to coordinate the design of the substation with the manufacturer of feeder busways where indicated and shall build into the substation(s) additional bus work with run back and transition sections to accommodate all connections. To accomplish this coordination, contact the busway manufacturer and contractor performing this work and base the arrangement on certified shop drawings. Provide all additional bus work and transition sections for complete installations.
3. Ground Bus: Provide a 1/4 inch x 2 inch copper ground bus the full length of the switchgear.
4. Neutral Bus: Provide a one-half capacity neutral bus the full length of the switchgear. Insulate the neutral bus from the switchgear structure and connect to the ground bus at one point by means of a disconnectable link.
5. Load Side Terminal Connections: Make all feeder breaker positions readily accessible from the rear for making up cable connections. Silver-plate contact surfaces of all bus and connections.
6. Switchgear Supporting Structure: Welded sheets and shapes, with rear portion containing bus bars, supports, and current transformers, with space for feeder cables entering from above or below. Do not locate terminal blocks, fuse blocks, or other accessory items in the rear bus compartments. Place circuit breakers and operating mechanisms in the front portion.
7. Individual Air Circuit Breaker Enclosures: Sheet steel compartments lined with arc resisting barriers where necessary and sealed to prevent flow of ionized gases into adjacent circuit breaker or bus compartments. Enclose each circuit breaker at the front by a hinged panel.
8. Louvers: Provide grille type louvers in doors for ventilation of ionized gases and in any other vertical part of the structure where necessary to insure a maximum internal air temperature of 15 degC rise above room temperature.
9. Bolt adjacent frames together and ship the entire structure on a steel base suitable for setting on a finished concrete floor.
10. Do all wiring within the switchgear with single conductor, stranded copper, tinned wire, with NEC Type SIS insulation for 600 volts working and 1500 volts test, rated 90 degC for switchboard wiring.
11. 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.
12. Provide vertical wireways where required.
13. Provide molded type terminal blocks with washer head binding screws complete with white marking strip.
14. Connect all current transformer secondary leads to accessible short circuiting terminal blocks with provisions for retention of the shorting devices.
15. Provide plug-in terminal blocks for all conductors to be continued across all shipping splits.
16. Provide wire markers at each end of all control wiring conductors.

17. Finish exterior and interior surfaces of the entire assembly with a gray synthetic lacquer or enamel, ANSI Standard No. 61.
18. Provide nameplates with suitable engraved letters on each incoming primary section, on each compartment door and for each control device on the front of the compartment doors. Use laminated black plastic nameplates with white engraved letters.
19. Stencil identification adjacent to all relays and control devices located behind compartment doors.

PART 3 EXECUTION

3.1 MANUFACTURING, DELIVERY AND FIELD SERVICES

A. General
1. The manufacturer shall design, build, test and arrange for shipment of the substations.
2. The manufacturer shall prepare and deliver the required drawings and instruction manuals with the equipment.

B. Site Preparation
1. The OWNER will prepare the site for installation of the equipment.

C. Installation
1. The OWNER will arrange for installation of the equipment.
2. Shipping splits shall be able to pass through a 8’ x 10’ hatch (or door) opening.
3. The equipment will be installed in accordance with local codes and the manufacturer’s recommendations.

3.2 FIELD QUALITY CONTROL

A. Field Services
1. Engineering field services shall include, but not be limited to the following:
2. Incoming line sections.
   a. Re-examine switches for evidence of shipping storage, or handling damage.
   b. Identify damaged parts and reorder.
   c. Determine that shipping devices and tags have been removed or direct the removal of blocking.
   d. Operate manually to check operation of auxiliaries and interlocks. Check contact wipe, gaps, and clearances as described in manufacturer’s instruction book.
   e. If equipped with electrical operation, test several times in accordance with instruction book.
   f. Verify key interlocks.
   g. Furnish check list copy to service engineer at time of inspection.
   h. Sign and return checkout list to OWNER stating that equipment is ready for energization.
3. Transformers
   a. Re-examine each transformer and accessories for evidence of shipping, handling, or storage damage.

b. Identify damaged parts and assist purchaser/user in filing claims, ordering, and expediting parts.
c. Determine that shipping devices have been removed or direct removal of braces and blocking.
d. Review field assembly work and determine to the extent possible that work is done in accordance with instructions.
e. Check temperature relays, meters, and alarms for correct installation.

4. Secondary switchgear
   a. Re-examine equipment for evidence of parts that may be damaged.
   b. Identify damaged parts and reorder. Expedite equipment delivery.
   c. Determine that shipping devices and tags have been removed or direct removal of wires, blocks, and braces that remain.
   d. Ensure that line-up is level, secured to foundations, physically connected to grounding system, and doors swing correctly.
   e. Identify adjustment required to meet specifications.
   f. Examine insulation and assembly of primary bus, ground bus, control relaying and metering connections at shipping splits.
   g. Identify and direct changes or corrections necessary.
   h. Test for circuit integrity with a megohm meter. Visually inspect portion of bus between transformer secondary and main breaker or disconnect transformer and check the bus with megohm meter if conditions dictate.
   i. Check that primary and control connections are made. Ensure that control voltages are consistent with equipment furnished.
   j. Check integral breaker lifting or engaging device for correct operation and attachment to the housing.
   k. Inspect individual breakers, insert breakers in housings, check positioning and equipment interlocks.
   l. Operate racking mechanisms to demonstrate smooth operation.
   m. Identify and direct adjustments required to achieve performance.
   n. Energize control circuits and test the integrity of close and trip circuits by opening and closing control switches and relay contacts to trip inserted breakers. If unit is equipped with static devices, test with a static test set.
5. Breakers
   a. Re-examine breakers for evidence of shipping, storage, or handling damage.
   b. Identify damaged parts and reorder.
   c. Determine that shipping devices and tags have been removed or direct the removal of blocking.
   d. Operate breakers manually and electrically to check operation of auxiliaries and interlocks.
   e. Check contact wipe, gaps, and clearances as described in the manufacturer’s instruction book.
6. Set and calibrate meters, instruments, protective devices, trip units and control in conjunction with ARCHITECT-ENGINEER’S recommendations depicted on DRAWINGS, and SPECIFICATIONS.
7. The service engineer shall also provide on-site training for the OWNER’S operating and maintenance personnel in proper operation and maintenance of the equipment. The training period of two days will be per OWNER’S schedule.

3.3 INSTALLATION

A. Provide a concrete pad with level surface four (4) inches above the finished floor in the location indicated for the equipment.

B. If recommended by the equipment manufacturer or indicated, provide leveling channels flush with the surface of the equipment pad.

C. Assemble and anchor the equipment.

D. Perform and report upon all ELECTRICAL ACCEPTANCE TESTS and adjustments required by SECTION 16999 of this SPECIFICATION.

E. Furnish the services of a qualified service engineer at the Project Site for not less than three consecutive days for de-bugging and checking of the equipment after installation. The service engineer shall verify calibration of all relays and instruments. The service engineer shall also train the operating and maintenance personnel in proper operation and maintenance of the equipment.

END OF SECTION

Revision History	
Date	**Rev. No.**
A	0
B	0
D	0
E	0
F	0
02-19-09	0

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