26 05 45 - MEDIUM VOLTAGE SF6 SWITCH

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Testing of SF6 Switches: Section 26 05 53.

1.02 DESCRIPTION

A. This Section includes Specifications for purchasing, installing, testing and energizing the equipment. Contractor shall conform to all requirements of this Section, including quality assurance, submittals, product handling, and warranties, as applicable for the specific extent of furnishing or installing responsibilities. Contractor shall confirm and verify with Owner all installation conditions that may affect furnishing specified equipment. Contractor shall confirm and verify with Owner all characteristics (including specific models, types, and similar properties) and conditions of equipment that may affect installing equipment.

B. Contractor-purchased equipment: Three-phase, gang operated, 15kV, 600A, 60 Hz., dead front, front access pad mounted sectionalizing switchgear. The switchgear shall consist of a single self-supporting outdoor enclosure, SF6 insulated switch with linear puffer switches.

1. The SF6 Padmount Style Resettable Fault Interrupter Switch shall be manufactured by Canada Power Products – no other equal.

1.03 APPLICABLE STANDARDS

A. All portions of ANSI, IEEE, NEMA and ASTM standards for padmount switch with accessories. B. Article 490.21(E) in the California Electric Code, which specifies that the interrupter switches in combination with power fuses or circuit breakers shall safely withstand the effects of closing, carrying and interrupting all possible currents up to the assigned maximum short-circuit rating.

1.04 SUBMITTALS

A. Shop drawings for equipment provided under this Section:

1. Shop drawings shall indicate the following:

   a. Physical dimensions and elevations showing:
1) High Voltage compartments and termination.
2) Anchor bolt locations.
3) Ground pad locations.
4) Location of accessories.
5) Total weight and center of gravity.

2. Complete Bill of Materials for switch and all accessories with component rating data.

3. When manufacturer’s reference numbers are different from those specified, provide correct cross reference number for each item. Shop drawings shall be clearly marked and noted accordingly.

4. When equipment and items specified include accessories, parts and additional items under one designation, shop drawings shall be complete and include required components.

5. Submit shop drawings as soon as practicable after signing contracts. Shop drawings must be approved before purchase and construction of equipment.

6. Shop drawings, which are not complete or not properly checked, will be rejected.


B. Instruction Manuals:

1. Upon completion of work, and before final acceptance of the system, furnish to Owner/Engineer for approval, 3 instruction and maintenance manuals.

2. Manual shall include the following:
   a. Manufacturer’s operating and maintenance instructions and parts lists of items or equipment. Where manufacturer’s data includes several types or models, applicable type or model shall be designated.
   b. Wiring diagrams for systems.
   c. Additional information, diagrams or explanations as designated under respective equipment or systems specification section.
   d. Instruct Owner’s representative in operation and maintenance of equipment. Instruction shall include a complete operating cycle on all apparatus. Allow a minimum of four hours for site training of Owner’s personnel.
   e. Operation manuals and instructions to Owner are of prime importance and shall be provided prior to request for final payment.
1.05 GUARANTEE

A. Guarantee for one year after energization of equipment, all equipment, materials, and workmanship to be free from defect.

B. Provide replacement parts for components found defective at no extra cost to Owner.

1.06 SITE CONDITIONS

A. Temperature: 30° - 110°F.

B. Elevation: Less than 500 feet above sea level.

C. Seismic Zone: 4 (CBC).

D. Precipitation: 30” per year.

E. Location: The project site is located approximately 5 miles off the Pacific Ocean.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. Acceptable Manufacturers: Canada Power Products. No other known equal.

B. Pad-mounted gear shall be in accordance with the one-line diagram and shall conform to the project specifications.

C. Pad-mounted gear shall consist of a single self-supporting enclosure, containing SF6 switch with necessary accessory components, completely factory-assembled, and all other necessary components. Interrupter switches shall be enclosed within an inner grounded steel compartment for electrical isolation and for protection from contamination. Switch terminals shall be equipped with bushings rated 600 amp continuous. Resettable Fault Interrupter positions shall be equipped with deepwell bushings rated 200 amp continuous to provide for load break elbow connection. No protective device elements shall be installed in the SF6 switch tank where they are not accessible or removable without entering the tank. Bushings and bushing wells shall be mounted on walls of inner compartment and shall extend into termination compartment. Termination compartments shall be as follows: one for each 3-phase switch, one for each 3-phase set of 200A RFI, and one for each 3-phase set of bus terminals.

D. Conductors and load break elbows for the potential transformers shall be included.

E. Equipment Description

Item: 1 S201-13-A Replacement Quantity: 1

Manufacturer: Canada Power Products, no other equal.
Description:

- 15KV, 95KV BIL
- 2-600A PufferPak switched ways, 2-RFI 200A ways.
- 3 phase, 2 position (open-close)
- Padmount Enclosure will be 12-gauge mild steel, tamper-resistant single side access with 3-point latch, double doors and a hinged hood. Equipped with stainless steel hardware, wind stops, padlock provisions and a penta-head bolt. The enclosure will be completely removable from the switch to facilitate installation, maintenance and, if necessary, replacement. Enclosure to be painted Munsell#7.0GY 3.29/1.5 and meet ANSI C57.12.28.
- Factory filled with SF6 gas.
- Removable Operating handles with padlock provision in the open and closed position, capable of operation by hookstick or rope with direction of movement clearly indicated.
- One (1) removable fiberglass operating handle
- Stainless steel nameplates providing information including ratings, contact position indication, circuit configuration and phase identification.
- Colour coded pressure gauge for visual indication of normal operating range, enclosed in a protective housing to prevent damage.
- Viewing window which provides fault interrupter position status.
- Brass fill valve for field addition of SF6 protected and sealed with a removable cap.
- Clamp type ground lugs, one for each set of bushings.
- Stainless steel switch tank for maximum corrosion resistance.
- 200 Amp deepwell or 600 Amp apparatus welded bushings, with protective shipping caps (elbows and inserts furnished by Contractor).
- Lifting and mounting provisions.
- Parking stands on 200 Amp ways.
- Motor-operators for SCADA switching.
- Motor-operators, voltage and current sensors for Automatic Load Transfer switching.
- Fault interrupter remote status.
- Resettable Fault Interrupters with vacuum fluorescent display control box and trip unit.
- Canada Power Products Trip Controls for Resettable Fault Interrupters.
- Dual ratio 600:0.5A and 200:0.5A current transformers for Canada Power Products Trip Controls.
• Potential Transformers for control and monitoring equipment, including conductors and loadbreak elbows.
• Window for RFI close-open position indication.

**Item: 2 S160-13-A Replacement  Quantity: 1**

Manufacturer: Canada Power Products, no other equal.

**Description:**

• 15KV, 95KV BIL
• 3-600A PufferPak switched ways, 3-RFI 200A ways.
• 3 phase, 2 position (open-close)
• Padmount Enclosure will be 12-gauge mild steel, tamper-resistant single side access with 3-point latch, double doors and a hinged hood. Equipped with stainless steel hardware, wind stops, padlock provisions and a penta-head bolt. The enclosure will be completely removable from the switch to facilitate installation, maintenance and, if necessary, replacement. Enclosure to be painted Munsell#7.0GY 3.29/1.5 and meet ANSI C57.12.28.
• Factory filled with SF6 gas.
• Removable Operating handles with padlock provision in the open and closed position, capable of operation by hookstick or rope with direction of movement clearly indicated.
• One (1) removable fiberglass operating handle
• Stainless steel nameplates providing information including ratings, contact position indication, circuit configuration and phase identification.
• Color coded pressure gauge for visual indication of normal operating range, enclosed in a protective housing to prevent damage.
• Viewing window which provides fault interrupter position status.
• Brass fill valve for field addition of SF6 protected and sealed with a removable cap.
• Clamp type ground lugs, one for each set of bushings.
• Stainless steel switch tank for maximum corrosion resistance.
• 200 Amp deepwell or 600 Amp apparatus welded bushings, with protective shipping caps
• (elbows and inserts furnished by Contractor).
• Lifting and mounting provisions.
• Parking stands on 200 Amp ways.
• Motor-operators for SCADA switching.
• Motor-operators, voltage and current sensors for Automatic Load Transfer Switching.
• Fault interrupter remote status.
• Resettable Fault Interrupters with vacuum fluorescent display control box and trip unit.
• Canada Power Products Trip Controls for Resettable Fault Interrupters.
• Dual ratio 600:0.5A and 200:0.5A current transformers for Canada Power Products Trip Controls.
• Potential Transformers for control and monitoring equipment, including conductors and loadbreak elbows.
• Window for RFI close-open position indication.

F. Ratings:

1. Ratings for all integrated pad-mounted gear shall be as shown below:
   a. kV, Nominal Operating Voltage: 12.47
   b. kV, Maximum Rated: 15
   c. kV, BIL 95
   d. Main Bus Continuous, Amperes 600
   e. Three-Pole Interrupter Switches:
      1) Line Switches, Amperes 600
      2) Momentary Ratings (ASYM) 40 KA
      3) Fault-Close Current (ASYM) 40 KA
      4) One Second Rating (SYM) 25 KA
      5) Rated Frequency 60 Hz.
   f. Resettable Fault Interrupter Ratings:
      1) Tap Switches, Amperes 200
      2) Momentary Ratings (ASYM) 19.2 KA
      3) Fault-Close Current (ASYM) 19.2 KA
      4) One Second Rating (SYM) 12 KA
      5) Rated Frequency 60 Hz.

G. Enclosure:
1. Pad-mounted gear enclosed shall be unitized monocoque (not structural-frame-
and bolted-sheet) construction of 11-ga hot-rolled, pickled and oiled steel sheet to
maximize strength, minimize weight, and inhibit corrosion. Structural joints and
butt joints shall be welded and external seams shall be ground flush and smooth.
Gas-metal-arc welding process shall be employed to eliminate alkaline residues
and to minimize distortion and spatter.

2. Base shall consist of continuous 90-degree flanges, turned inward and welded at
corners, for bolting to concrete pad.

3. Door openings shall have 90 degree flanges, facing outward, that shall provide
strength and rigidity as well as deep overlapping between doors and door
openings to guard against water entry.

4. Gasketing shall be provided between roof and enclosure to guard against entry of
water and airborne contaminants and shall discourage tampering or insertion of
foreign objects.

5. Provide heavy coat of insulating "no-drip" compound to inside surface of roof to
minimize moisture condensation.

H. Doors:

1. Doors shall be constructed of 11-ga hot-rolled, pickled and oiled steel sheet.

2. Door-edge flanges shall overlap with door-opening flanges to discourage
tampering or insertion of foreign objects.

3. Doors shall have minimum of 2 stainless steel hinges with stainless-steel hinge
pins and interlocking hinge supports for full length of door to provide strength,
security, and corrosion resistance. Mounting hardware shall be stainless steel and
shall not be externally accessible to guard against tampering.

4. Doors shall be hinged at sides to swing open with minimum effort. Doors hinged
at top requiring significant effort to lift open shall not be allowed.

5. In consideration of controlled access and tamper resistance, each door (or set of
double doors) shall be equipped with automatic three-point latching mechanism.

6. Pentahead socket wrench or tool shall be required to unlatch door.

7. Latching mechanism shall have provisions for padlocking that incorporate a
means to protect padlock shackles from tampering and shall be coordinated with
the latches such that:
   a. It shall not be possible to unlatch mechanism until padlock is removed and it
      shall not be possible to insert padlock until mechanism is completely latched
      closed.

8. Provide each door with galvanized steel door holder located above door opening.
Holder shall be hidden from view when door is closed and it shall not be possible
for holder to swing inside enclosure.
I. Finish:

1. After pretreatment, protective coatings shall be applied to resist corrosion and protect steel enclosure. To establish capability of finishing system to resist corrosion and protect the enclosure, representative test specimens shall satisfactorily pass the following tests:

   a. 4000 hrs of exposure to salt-spray testing per ASTM B 117 with underfilm corrosion not to extend more than 1/32" from scribe and loss of adhesion from bare metal not to extend more than 1/8" from scribe.

   b. 1000 hrs of humidity testing per ASTM D 2247 with no blistering as evaluated per ASTM D 714.

   c. 500 hrs of accelerated weathering testing per ASTM G 53 with no chalking as evaluated per ASTM D 659 and no more than 15% reduction of gloss as evaluated per ASTM D 523.

   d. Crosshatch adhesion testing per ASTM D 3359 Method B with no loss of finish.

   e. 160-inch-pound impact adhesion testing per ASTM D 2794 with no chipping or cracking.

   f. Scab corrosion testing for 35 cycles with exposure to specific salt mist, temperature, and relative humidity conditions for designated time intervals followed by air blow-off adhesion test per ASTM D 1654 with creepage from scribe not to extend more than 1/16" and no unusual surface failure.

   g. Oil resistance testing consisting of 72-hour immersion bath in mineral oil with no shift in color, no streaking, no blistering, and no loss of hardness.

   h. 3000 cycles of abrasion testing per ASTM 4060 with no penetration to substrate.

2. Certified test abstracts substantiating above capabilities shall be furnished upon request.

3. After finishing system has been properly applied and cured, welds along enclosure bottom flange shall be coated with wax-based anticorrosion moisture barrier for added corrosion resistance.

4. Finish shall be olive green, Munsell 7GY3.29/1.5

5. To guard against corrosion, hardware (including door fittings, fasteners, etc.), operating-mechanism parts, and parts subject to abrasive action from mechanical motion, shall be of stainless-steel materials. Do not use Cadmium-plated ferrous parts.

6. Enclosure shall conform to requirements of ANSI C57.12.28 for degree of tamper resistance.
J. Bushings and Bushing Wells:
   2. Bushings and bushing wells shall be cycloaliphatic epoxy resin with characteristics and restrictions as follows:
      a. Operating experience of at least 10 years under similar conditions.
      c. Adequate strength for short-circuit stress established by test.
      d. Conformance with applicable ANSI standards.
      e. Homogeneity of cycloaliphatic epoxy resin throughout each bushing or bushing well to provide maximum resistance to power arcs. Ablation due to high temperatures from power arcs shall continuously expose more material of same composition and properties so no change in mechanical or electrical characteristics takes place because of arc-induced ablation.
   3. Bushings and bushing wells shall be mounted so semiconductive coating is solidly grounded to the enclosure.
   4. Bushings rated 600 amp continuous shall have removable threaded stud so bushings are compatible with 600-amp elbow systems - those requiring a threaded stud as well as those that do not.

K. Terminations
   1. Termination compartments for bus shall have bushing wells to permit connection of elbows. Bushing wells shall be mounted on interior wall at minimum height of 25" above enclosure base. All terminations shall be accessible and 36" unobstructed.
   2. Termination compartments for bushings rated 600 amp continuous shall be of adequate depth to accommodate two 600-amp elbows mounted piggyback, encapsulated surge arresters or grounding elbows mounted on 600-amp elbows having 200-amp interfaces, or other similar accessory combinations without need for an enclosure extension.
   3. Termination compartments for bushing wells rated 200 amperes continuous shall be of an adequate depth to accommodate 200-ampere elbows mounted on portable feedthrus or standoff insulators, or other similar accessory combinations without need for an enclosure extension.
   4. Termination compartments shall be provided with one parking stand for each bushing or bushing well. Parking stand shall be located immediately adjacent to associated bushing or bushing well and shall accommodate standard feed-thru
and standoff insulators, and other similar accessories. 200A positions shall accommodate installation of bushing CT’s without field modification.

5. Equip each termination compartment for switch with viewing window to allow visual inspection of interrupter switch blades and allow positive verification of switch position.

L. Interrupter Switches:

1. Interrupter switches shall be enclosed in inner steel compartment and shall be provided with bushings rated 600 amp continuous to permit connection of elbows external to switch compartment.

2. Resettable Fault Interrupter switches shall have two-time duty-cycle fault-closing rating equal to or exceeding short-circuit rating of pad-mounted gear. Ratings shall define ability to close interrupter switch twice against 3-phase fault with asymmetrical current in at least one phase equal to rated value, with switch remaining operable and able to carry and interrupt rated current. Tests substantiating these ratings shall be performed at maximum voltage with current applied for at least 10 cycles.

3. Interrupter switches shall be externally operable. Each switch shall be padlockable. Stops shall be provided to prevent over travel and guard against damage to interrupter switch quick-make quick-break mechanism. Provide labels to indicate switch position in switch operating-hub packet.

4. Each interrupter switch shall be provided with folding switch-operating angle. Switch-operating handle shall be secured to inside of switch-operating-hub pocket by brass chain. Folded handle shall be stored behind closed switch-operating-hub access cover.

5. SF6 gas shall be used as a dielectric and interrupting medium.

6. A brass SF6 fill valve, protected and sealed with a removable cap, shall be located on the switch front panel.

7. Viewing windows shall be provided for positive confirmation of visible break of switch operator positions.

8. Interrupter switches shall use quick-make quick-break mechanism installed by switch manufacturer. Quick-make quick-break mechanism shall be integrally mounted on switch frame, and shall swiftly and positively open and close interrupter switch independent of switch-operating-hub speed.

9. Each interrupter shall be completely assembled and adjusted by switch manufacturer on single rigid mounting frame. Frame shall be welded steel construction such that frame intercepts leakage path which parallels open gap of interrupter switch to positively isolate load circuit when interrupter switch is in the open position.
10. Interrupter switch contacts shall be backed up by stainless steel springs to provide constant high contact pressure.

11. Provide interrupter switches with single blade per phase for circuit closing including fault current, continuous current carrying, and circuit interrupting. Spring-loaded auxiliary blades shall not be permitted. Interrupter switch blade supports shall be permanently molded in place in a unified insulated shaft constructed of same cycloaliphatic epoxy resin as insulators.

12. Circuit interruption shall be accomplished by use of interrupter which is positively and inherently sequenced with blade position. It shall not be possible for blade and interrupter to get out of sequence. Circuit interruption shall take place completely within interrupter, with no external arc or flame. Any exhaust shall be vented in controlled manner through deionizing vent.

13. Switch operators shall be manually operable in the event of loss of control power. The operator mechanism shall be located on the outside of the switch tank and shall be easily replaceable.

14. The switch tank shall be hermetically sealed and filled with SF6 gas to a pressure of 10 psig. A permanent style pressure gauge shall be installed on the unit for verification of positive pressure. The tank shall be constructed of stainless steel with all welded construction.

M. Fuses:

1. Fusible elements shall be non-aging and non-damageable so it is unnecessary to replace unblown companion fuses on suspicion of damage following a fuse operation.

2. Arcing accompanying fuse operation shall be contained within fuse, and arc products and gases shall be contained within exhaust control device during fuse operation.

3. Fusible elements for refill units or fuse units shall be helically coiled to avoid mechanical damage due to stresses from current surges.

4. Fusible elements, that carry continuous current, shall be supported in air to help prevent damage.

5. To protect fuse-handling mechanism from corrosion, all mechanism parts shall be painted or made of corrosion-resistant materials, or otherwise be protected from corrosion. Latches and pivots shall be stainless steel or zinc-nickel plated steel with nylon or plastic bushings.

6. Opening into component compartment shall be covered by fuse-access panel in both open and closed positions to help prevent inadvertent access to high voltage.
7. Access to fuse sections shall be such that replacement of fuses in one compartment shall not require opening of interrupter switch.

8. Cable guides shall be provided in each termination compartment for a set of fuses to prevent cable from interfering with rotation of fuse-access panel.

9. Provide fuse-handling tool as recommended by fuse manufacturer.

10. Provide spare set of fuses for each potential transformer.

11. Fuses shall be accessible without having to de-energize or disassemble the switch.

N. Controls:

1. Each 200A RFI switch shall be equipped with one (1) electronic power fuse and relay emulator with three (3) bushing mounted window type current transformers.

2. Overcurrent sensing shall be accomplished with an electronic trip control. The control shall be Canada Power Products (no acceptable equal). The controls shall use current transformers external to the tank to sense the load currents. The current transformers will provide power to the electronic trip control. No external power shall be required. The current transformers shall be dual ratio 600:0.5A and 200:0.5A. In order to provide immunity to system voltage disturbances (i.e. transients) the control will not be sensitive to system voltage conditions. The control shall be fully operable and meet the specified time-current curves when energized. Trip controls shall include a vacuum fluorescent display (VFD) with keypad as the user interface.

3. The VFD shall be legible at –40°C without the need for a heater (Operating range –40°C to +65°C). The external current transformers on the switch will energize the display, when load current is flowing. In the event the switch is de-energized, a 9V-lithium battery shall be included to allow operation of the display and keypad for data gathering and parameter setting. The keypad shall be used to select the following parameters: TCC Fuse Curves, TCC Fuse Rating, Instantaneous Trip, Ground Fault Pick-Up, Ground Fault Delay and Protection Mode. The VFD shall display the above data as well as the cause of trip. The electronic control shall have the ability to store up to 64 different TCC curves. Trip selection to be available in 12 positions from 10 to 450 amps.

4. Instantaneous trip values shall be in multiples of 1.5-12 times the current transformers primary ratings in increments of 50% of the current transformer primary rating with values from 300A to 7200A. Ground fault trip settings shall range from 10-30% of the current transformer primary rating in increments of 5% of the current Transformer primary rating. Ground fault time delay shall be selectable in 10 settings from .05 to 1.0 seconds.

5. A RS232 port shall be provided for communication with external devices.
6. A manual trip button shall be supplied to electrically trip the interrupter. Provisions for remote trip shall be provided.

2.02 LABELING

A. External doors and hinged bolted panels providing access to high voltage shall be provided with "Danger - High Voltage - Keep Out" signs. Internal doors shall be provided with warning signs indicating, "Switch Blades may be Energized in any Position".

B. SF6 switch assembly shall be provided with nameplate indicating the manufacturer’s drawing number and the following: voltage ratings (KV nominal; KV, maximum design; KV, BIL); main bus continuous rating (amperes); short-circuit ratings (amperes, rms symmetrical and MVA three-phase symmetrical at rated nominal voltage); and the monetary and fault-closing ratings (amperes, rms asymmetrical).

C. Submit identification labels for switch, switch ways, cable terminations, and all other required labels to Owner for approval as required in Section 16030. Owner reserves the right to modify identification label prior to approval of shop drawings or labels.

PART 3 - EXECUTION

3.01 INSPECTION

A. Visually inspect equipment and components at time of delivery. Replace damaged components at no additional cost to Owner.

3.02 INSTALLATION

A. Contractor to install equipment per manufacturer’s recommendations and as indicated. Coordinate final locations of equipment with Owner and General Contractor and review final locations with Engineer prior to setting equipment.

B. Switch tanks, mounting frames and operating mechanisms shall be solidly bonded to the station ground counterpoise in accordance with ANSI C37.72 and Section 16450.

C. Protect equipment during installation to prevent twisting or deformations, exposure to damaging environments, and work of other trades. Maintain protection until completion of construction.

D. Equipment shall have passed applicable acceptance tests before energization as required in the project specification Section 26 05 53.

3.03 ADJUSTMENTS AND CLEANING
A. Immediately prior to final inspection, make final adjustments and thoroughly clean equipment. Refinish damaged enclosures to original quality.

B. Provide painted covers and hardware with reinforcement against deflection to close openings in all SF6 switch support structures. All corroded covers shall be replaced with new covers and new fastening hardware. Stainless Steel hardware shall be used in all outdoor and wet areas and where subject to flooding. Paint color to match existing.

3.04 ACCEPTANCE TESTING

A. Inspect, test and submit test reports on equipment and work in accordance with Section 26 05 53 of this specification and manufacturer's recommendations. Apply settings to all trip units and electronic controls in accordance with the Owner's Coordination Study. Request settings four weeks prior to performing any tests and making any settings. Adjust or replace equipment as needed to comply with manufacturer's specifications and submit new test reports.

END OF SECTION 26 05 45