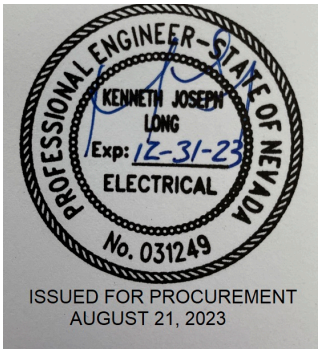
Specification No. 33 77 23

VACUUM MEDIUM-VOLTAGE CIRCUIT BREAKER

Southern Nevada Water Authority

69-12.47 kV Monthill Substation
Las Vegas, NV

August 4, 2023



Kenneth J Long, PE

Digitally signed by Kenneth J Long, PE
Date: 2023.08.22 21:16:11 -07'00'

3010 W Charleston Blvd Suite 100
Las Vegas, NV 89102-1969

Project No. 3636S (181301299)

Stantec

Revision Chart

Rev.	Reason for Change	Author	Review	Issue Date
A	Released for Client Review	KJL	CAL	01/13/2023
B	Comment Revisions	KJL	MR	05/03/2023
C	SNWA Comment Backcheck Revisions	KJL	LH	08/03/2023
D	Final Backcheck	KJL	MR	08/21/2023

SECTION 33 77 23

VACUUM MEDIUM-VOLTAGE CIRCUIT BREAKER

PART 1 - GENERAL

1.1 SUMMARY

A. The specific application for the medium-voltage circuit breaker (MVCB) is a main power transformer low-side main circuit breaker, providing fault interruption and switching capability for both the transformer and the medium-voltage switch and bus. The MVCB is to be specifically rated, designed, manufactured, and tested for this application.

B. The MVCB is described as a 15 kV voltage class medium-voltage circuit breaker, outdoor, free-standing, dead-tank design, comprised of three (3) group-operated poles, with a common stored-energy operating mechanism, operating at a maximum voltage of 15.5 kV in a non-coastal environment up to 3,300-feet.

C. This specification is for a 12.47 kV medium-voltage IEEE C37.04 Class C1 Circuit Breaker, which is specifically intended to provide fault interruption and switching capability for capacitive and reactive circuits. The intention is to obtain a MVCB which utilizes an interrupter to interrupt current and voltage associated with an application requiring a low probability of restrike when switching capacitive current under rated conditions. The MVCB is intended to be used in conjunction with an underground cable system where repeated reclosing is not required (class S1 application). The MVCB is required to have normal mechanical endurance (class M1 application).

D. Energized current carrying components associated with each phase (pole) are to be contained within an air-insulated compartment at atmospheric pressure, with separate porcelain or composite bushings on each side of the interrupting contacts.

1.2 REFERENCES

A. Institute of Electrical and Electronics Engineers:
   1. IEEE C2-2023 - National Electric Safety Code
   2. IEEE C37.04-2018/Cor 1-2021 - Standard for Ratings and Requirements for AC High-Voltage Circuit Breakers with Rated Maximum Voltage Above 1000 V – Corrigendem 1
   3. IEEE C37.06.1-2017 - Recommended Practice for Preferred Ratings for High-Voltage (>1000 volts) AC Circuit Breakers Designated Definite Purpose for Fast Transient Recovery Voltage Rise Times
   4. IEEE C37.09-2018 - Test Procedure for AC High-Voltage Circuit Breakers Rated on Symmetrical Current Basis
   5. IEEE C37.11-2022 - Requirements for Electrical Control for AC High-Voltage (>1000 V) Circuit Breakers
   6. IEEE C37.012-2022 - Guide for the Application of Capacitance Current Switching for AC High-Voltage Circuit Breakers Above 1000 V
   7. IEEE C37.20.2-2016 - Standard for Metal-Clad Switchgear
   8. IEEE C37.100.1-2018 – Standard of Common Requirements for High-Voltage Power Switchgear Rated Above 1000 V
   9. IEEE C57.13-2016 - Standard Requirements for Instrument Transformers

10. IEEE C57.19.00-2004 - Standard General Requirements and Test Procedures for Power Apparatus Bushings
11. IEEE 693 – Recommended Practice for Seismic Design of Substations

B. Insulated Cable Engineers Association:
1. ICEA S-73-532-2014 - Standard for Control, Thermocouple, Extension and Instrumentation Cable
2. ICEA S-95-658-2021 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy

C. National Electric Manufacturers Association:
1. NEMA 250-2020 - Standard for Enclosures for Electrical Equipment (1000 Volts Maximum)
2. NEMA SG4-2009 (R2013) - Alternating-Current High Voltage Circuit Breaker
3. NEMA CC 1-2018 Electric Power Connections for Substations

D. National Fire Protection Agency Standards:
1. NFPA 70-2023 - National Electrical Code

E. Society of Protective Coatings (SSPC):
1. SSPC-SP1 – Solvent Cleaning
2. SSPC-SP2 – Hand Tool Cleaning
3. SSPC-SP3 – Power Tool Cleaning
4. SSPC-SP5 – White Metal Blast Cleaning
5. SSPC-SP6 – Commercial Blast Cleaning
6. SSPC-SP7 – Brush-off Blast Cleaning
7. SSPC-SP10 – Near-White Blast Cleaning

1.3 SUBMITTALS

A. Submit product data under provisions of Section 700.

B. Include an outline drawing showing support point dimensions for the base mounting, minimum and maximum heights to energized components, bushing terminal pad detail, grounding pad detail, bushing creepage and strike distances, weight, center of gravity, lifting points, and access detail for the interface wiring terminal cabinet.

C. Additional information included in the outline drawing: enclosure interior and exterior paint colors, height from foundation to bottom of control compartment(s), maximum cantilever moments, and other civil parameters required for anchorage design by others.

D. Include a nameplate drawing showing at minimum the manufacturer’s type or model number, serial number, and year of manufacture; total weight, insulation medium and volume; maximum system voltage, power frequency withstand voltage, basic impulse level (BIL); rated frequency, voltage, and current; interrupting current ratings, switching current ratings.

E. Where applicable, provide an auxiliary nameplate for the bushing current transformers (BCTs), including ratio, accuracy, burden, and thermal rating.

F. Provide a schematic drawing showing the trip and close circuitry, diagram of connections, naming conventions and interfaces with the Owner's control and protection circuits, station service connections and overcurrent protection devices, and operator charging motor circuitry.

G. Provide a three-line diagram showing the breaker's bushings, interrupter, and locations, designations, and polarity of BCTs.

H. Submit a breaker Test Plan and Procedure Outline document for approval prior to performing routine factory acceptance tests.

I. Submit test data that contains, at minimum, testing criteria as specified in IEEE C57.19.00 and C57.13, and C37.09:
   1. Applicable Design test (for a production lot)
   2. Applicable Production tests
   3. Applicable Routine tests
   4. Accuracy, ratio, and phase angle measurements
   5. High-Potential withstand tests

1.4 DELIVERY, STORAGE, HANDLING, AND ANCHORAGE

A. Store and protect products under provisions of Section 800; 3.

B. Store in a location free from traffic hazards on a level concrete pad or foundation.

C. Handle breakers using only lifting eyes and brackets provided for that purpose.

D. The Supplier shall furnish and install at least one (1) separate impact recorder, with a sealed protective cover. Not less than one hour prior to scheduled departure of the circuit breaker from the factory, the Supplier shall start the recorder and verify that they are operating properly. The impact recorder shall provide a continuous digital record covering the entire shipment period. Data transmission shall be available to the Purchasing Authority on a real-time basis. Digital data logger and tracking module shall be equivalent to SMT and Hybrid, Model MONILOG devices. Impact data recordings shall be presented to the Purchasing Authority's Technical Representative for review.

E. Furnish suitable, safe means for off-loading breakers from transport at job site:
   1. Bushings wrapped and base support legs bolted to pallet.
   2. Freight damage and consequential damages shall be Bidder's responsibility.

F. Furnish foundation anchorage details for the breaker's support frame, including baseplate size and spacing, to accommodate anchorage either by welding baseplates to foundation embedment or epoxy set anchor bolts.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The following manufacturers and their respective breaker model or type are recognized as being appropriate for this particular application:
   1. ABB – Model: R-MAG or R-MEC
   2. EMA – Model VDH

3. Siemens – Model: SDV7-SE or SDV7-MA
4. Owner approved equal.

2.2 EQUIPMENT

A. Medium-Voltage Circuit Breakers:

1. The MVCB will be an outdoor type, Class S1, with weatherproof operator components. The bushings and pole orientation shall maintain sufficient separation between energized and de-energized components to maintain its rated BIL for service conditions up to an elevation of 3,300-feet above sea level. IEEE correction factors shall apply for operation above 3300-feet. The maximum ambient air temperature shall be 40°C, and the minimum shall be minus 30°C for "usual" service conditions. Site-specific elevation and ambient temperature range are listed below. Site-specific conditions outside of the "usual" temperature range shall be dealt with as an "unusual" service condition under the guidelines of IEEE C37.04, Section 4.
2. The MVCB is a three-pole, outdoor type, 60 hertz, classified as a dead tank, with a common height adjustable supporting frame, and free-standing air-insulated metal-enclosed vacuum interrupter. The MVCB will have a common operating mechanism for all three (3) poles. The rated interrupting time shall not exceed 3-cycles (50-milliseconds). General construction and fabrication requirements are outlined below. Specific continuous, momentary withstand, and interrupting current ratings, voltage ratings, and additional specific requirements are also outlined below.
3. The insulating column’s (bushing) weather-shed finish color shall be ANSI #70 light gray, or the Supplier’s standard approved equivalent finish color. The interrupter compartment, control cabinet, and any other compartment(s) shall also have a finish color of ANSI #70 light gray, or the Supplier’s standard approved equivalent finish color. Exterior surfaces may be left in their natural finish if galvanized, or constructed of either marine grade aluminum, cast aluminum, or stainless steel.
4. The breaker shall be designed with vacuum interrupters in a metal-enclosed air-insulated common compartment comprised of three (3) segregated compartments, one for the energized components, a second for the operator interface, and a third for interface with field installed wiring. Components mounted in the control compartment shall be panel mounted providing a "dead front" interface with operating personnel. The common compartment shall meet security requirements of IEEE C37.20.2 (Category C).
5. Primary terminals shall be a straight flat pad with NEMA CC 1 standard 4-hole drilling. The width and thickness of the terminal pad shall be appropriate for the continuous current rating of the circuit breaker. Circuit breakers rated 1200 A through 2,999 A continuous current shall have a 4-inch by 4-inch pad width (NEMA CC 1-2018). Although aluminum primary terminals are preferred, they may be either tin plated bronze, or aluminum; the minimum plating thickness shall be 0.0002-inch applied through a hot tin dipping process. If the bushings are supplied with threaded copper studs, then the studs shall be silver plated, and supplied with plated bronze stud-to-flat straight pad terminal connectors.
6. Circuit breaker support frame grounding terminals shall either be an integral part of the support frame and be drilled and tapped for a 2-hole NEMA connection, or a drilled 2-hole pad. Provide separate ground terminals on two (2) opposite support legs, no lower than 18 inches above

the top of the frame base plate. If the support frame is removed for shipping, provide a ground terminal on both sides of the joining flange to accommodate a visible ground jumper across the frame joints.

7. The MVCB shall be qualified according to the requirements of IEEE Standard 693. The assembled electrical equipment specified herein shall meet the requirements associated with the acceleration (post-installed) specified in Section H – Seismic Requirements (IEEE 693). Frequency modifying devices shall not be allowed.
8. Provide lifting gussets with eyes to accommodate handling and installation.

B. Operating Mechanism:
   1. The MVCB shall be furnished with a common operating mechanism for all three (3) poles.
   2. The stored energy mechanism shall be capable of performing the standard Open – Close-Open – 15 seconds – Close-Open reclosing duty sequence specified in IEEE C37.04, Section 5.10.
   3. The Supplier shall specify closing and reclosing times in their bid proposal.
   4. Type of Operating Mechanisms:
      a. The operating mechanism shall be one of the following stored-energy types: spring-hydraulic, motor-charged extended or compressed spring, or a spring-assisted magnetic-actuated employing both rare-earth magnets and electromagnetic force. The mechanism shall be equipped with control logic and mechanical linkages where necessary to provide the anti-pumping and trip-free features.
      b. In all cases, the operating drive mechanism will charge a stored energy device (spring or capacitor as applicable) upon the completion of a closing operation, which will not require additional application of the drive mechanism to perform an opening operation.
      c. If the operating mechanism is equipped with any other monitoring devices which will alarm an “abnormal” condition, then relay outputs from each monitor are to be wired to a terminal block for the Owner’s use.
      d. Where applicable, the operating mechanism is to be mechanically charged by an electrical motor rated for operation with either a preferred 120/240 V AC primary source or an alternate DC voltage power source. Refer to Section C, Electrical Characteristics, for the site specific DC voltage. Provide separate isolation and overcurrent protection for the operating mechanism’s charging (drive) motor power circuit. Additionally, provide a separate undervoltage alarm relay for the preferred AC source (Device Number 27-1), with a Form-B output contact from each providing alarm inputs to the local annunciator (Device Number 30, IN2) to change state when conditions are abnormal.
      e. Provide an automatic transfer scheme (Device Number 83M) to transfer to the Alternate DC supply input upon the loss of preferred AC power, and automatically revert upon AC power restoration.
      f. Where applicable, the mechanism’s charging motor shall be equipped with an excess run-time monitor (Device Number 84M) and thermal overload detection (Device Number 49M) which will alarm an “abnormal” condition. Provide a Form-B contact from each device for the Owner’s use.

g. The Supplier shall include, in the approval drawings, a listing of the inrush current required to charge the closing spring(s) at 120 V AC and the specified DC voltage alternate source.

5. Operating Mechanism Compartment:
   a. The group-operated MVCB is to be equipped with a common stored energy operating mechanism housed in either the common control compartment, with interior barriers to protect operating personnel from the moving parts of the mechanism, or in a separate compartment. The mechanism shall be accessible for maintenance by either opening latched compartment door(s) or removable panels. If applicable, the Supplier shall furnish all electrical connections between the operating mechanism compartment and the main control compartment. Access to the compartment style operator shall be through hinged and gasketed door(s), with a single rotating handle and multiple-point latching system.
6. Breaker Control Compartment:
   a. Provide a compartment (may be combined with operating drive mechanism compartment where applicable) with door gaskets, screened and filtered vents to inhibit the accumulation of blowing dust and snow within the compartment, and appropriate climate conditioning to house the control and operating components. A compartment equivalent to NEMA 3R may be used so long as the compartment can be made resistant to blowing dust and insects with the addition of interior filters over the screened louvers. Provide a means of escape for accumulated interior moisture.
   b. The compartment is to house the interface terminal blocks for terminating all electrical wiring. The Contractor will bring all external wiring in conduit or feed-through wireway to the breaker control compartment. The compartment shall be furnished with an interior mounted removable bottom (gland) plate for drilling, punching, or cutting to accommodate conduit/wireway field assembly. Access to the gland plate shall not be blocked by cross-bracing or other support frame features.
   c. The compartment doors shall be vertically hinged, removable, and operated by a single handle through a multiple-point latching system for each door. Each door shall be equipped with wind-stop hardware to secure the door while open. Door hardware shall be stainless steel.
   d. The control components, terminal blocks, and any other devices which may require access by operations and maintenance personnel shall be mounted in the compartment at a height less than 72-inches above foundation level. The bottom of the compartment shall be not less than 2-feet above foundation level. The compartment shall be furnished with a minimum of two (2) space heaters. Each heater shall be supplied by a separate circuit isolation and overcurrent protection device. One of the heater circuits will operate continuously unless disconnected manually by the isolation and overcurrent protection device. The remaining heater circuits shall be controlled by a thermostat. The thermostats shall be adjustable, and the adjustment provisions shall include clear indication of at least three specific temperatures on the adjustment range. Heating elements shall be rated for an input voltage of 240 V AC; however, they are to be connected for operation at 120 V AC (one-quarter the rated wattage).

e. Provide a copper ground bus within the control compartment(s) interior, with a visible bonded connection to an external connection point to receive the Owner's grounding pigtails. Provide a removable conduit access plate centered in the floor of the compartment. The plate shall be mounted within the interior of the compartment to facilitate removal during conduit or wireway installation.

7. Control Compartment Accessories and Wiring:

a. Auxiliary internal power and control wiring shall consist of stranded copper wire, 600-Volt class, with insulation (or outer covering over the insulation) that is flame-retardant, heat-resistant, oil-resistant, and moisture-resistant. Insulation shall be a thermoset material, and UL classified as either SIS for wiring within a control panel, or XHHW-2 for wiring within a conduit or wireway.

b. All wire terminations associated with field installed wiring shall be made on suitable molded, one-piece terminal blocks, with washer-less head binding screws. No wires shall be spliced. Both ends of all wires and all terminal block points shall be clearly marked with the designation shown on the Supplier 's wiring diagrams, and submitted to Owner for review and approval. Terminal blocks shall be rated 600 Volts AC, 30 A, equipped with #10–32 binding screws, and suitable for wire sizes #18 through #10 AWG. All wires terminated on these blocks shall have non-insulated ring-type terminals. Terminal blocks associated with the Contractor's AC and DC station service wiring terminations at the common control compartment shall be suitable for wire sizes up to and including #6 AWG.

c. Control, alarm, and status circuits between the control and relay output contacts and the Owner's interface terminal blocks shall be wired using #14 AWG single conductor SIS 600-Volt cable with a black or gray insulation color. Should the Supplier have a different insulation color standard than the insulation colors identified above, they are to provide a legend within their diagram of connections drawing(s) which identifies insulation colors by their function.

d. Provide a minimum 16-stage auxiliary switches (Device Number 52-1) with each operating mechanism to satisfy the operational control requirements associated with a complete MVCB. The 16-stage switch shall have either convertible contacts which may be configured as either a normally-open (Form-A) contact or a normally-closed (Form-B) contact, or half Form-A and half Form-B. Auxiliary switch operation shall be mechanically linked to the operational position of the breaker's primary interrupting contacts. If the MVCB is closed into a fault and trips open, the Form-B contacts shall remain open for a minimum of 0.025 seconds. Auxiliary switch contacts shall be rated for 600 V and a minimum of 10 A continuous current. In addition to those contacts required for operational control, all other contacts shall be wired to terminal blocks for the Owner's use.

e. Furnish either separate pushbuttons or a single rotary contact type, spring-return to normal, manually-operated breaker control switch(es) in the common control compartment, providing local "Open" and "Close" control of three-pole operation, and which is intended to be used for emergency, maintenance, or commissioning purposes only.

f. Trip and close cycles shall be completed for momentary operation of the control switch. Form-A contacts associated with the "Local" position of Device 43L/R will enable the pushbuttons to locally open and close the MVCB.

g. This control switch shall also be furnished by the Supplier with red and green indicating lights. The lights may be mounted adjacent to the control switch or be integral to the control switch. Either method shall employ LED indicating lamps.

h. Provide a red indicating light wired in series with the trip coil and a separate Form-A breaker auxiliary contact from Device Number 52-1. The “Red” indicating light shall illuminate when the MVCB’s main contacts are in the "Closed" position and the trip coil is operational. The Supplier shall provide a “Green” indicting light wired in series with a Form-B breaker auxiliary contact from Device Number 52-1. The green indicating light shall illuminate when the MVCB’s main contacts are in the "Open" position. Provide a nameplate adjacent to the indicating lights, with a brief description of its function or purpose.

i. The breaker trip circuit, close circuit, and the alarm circuits shall be DC powered. The operating mechanism’s charging motor and control compartment heaters shall be AC powered. The MVCB shall be equipped for operation with the AC or DC power supply voltages specified below. The Contractor will provide AC and DC power sources to the MVCB at the control compartment via the Supplier’s designated terminal blocks.

j. Furnish non-fused, 30 A minimum, 250 V DC, double-pole, single-throw, knife blade-type, gang-operated disconnect switches which are to be used for independently isolating the AC and DC control power circuits from their respective control power sources during maintenance. These switches must provide a means of preventing the electrical operation of the MVCB by any local or remote trip or close control input. Additionally, provide a DC undervoltage alarm relay for the (Device Number 27-2) control circuits, with a Form-C output contact set wired to terminal blocks for the Owner’s use.

k. The operating mechanism shall be furnished with a single primary DC trip coil. The primary trip coil and the close circuit shall be included in one DC control circuit. When specified In Section C, a secondary trip coil shall be included in a separate DC control circuit. The MVCB local control switch shall be a part of the same DC control circuit as the primary trip and close coils. The trip coil shall be rated at specified DC voltage and shall operate correctly for a minimum range of minus 60% and plus 15% of the nominal voltage rating.

l. The MVCB control circuitry shall include the operational features of a closing relay (Device 52X) which is to be used to seal in the equivalent of an anti-pump relay (Device 52Y) and initiate the breaker closing operation.

m. A remote protective relaying TRIP contact will be hard-wired as a common input to the breaker’s primary trip coil. A protective relaying CLOSE contact will be hard-wired as a common input to the breaker’s close coil. These remote trip and close circuits shall be brought to the MVCB’s interface compartment by the Contractor and terminated on the Supplier’s designated interface terminal blocks for the Owner’s use.

n. Provide a 2-position, manually operated control switch (Device Number 43L/R) in the common control compartment for locally enabling and disabling tripping and closing circuits. In the "Local" position, the switch will allow closing and tripping of the breaker via the local 52-CS switch(es) while disabling remote close and trip capability. In the "Remote" position, the switch will allow remote closing and tripping of the breaker but will block local closing and tripping via the 52-CS switch(es). In addition, a normally open contact of the 43L/R switch will be wired to the interface terminal blocks for the Owner's use to provide indication that the 43L/R switch is in the "Local" position.

o. The Contractor's control and alarm cables shall terminate on independent, 12-position terminal blocks. These terminal blocks shall be furnished by the Supplier in the common control compartment for the exclusive use of the Contractor. The purpose or function of each connection shall be identified on the wiring diagrams. Provide terminal block(s) intended to terminate cable sizes up to and including #8 AWG copper associated with station service AC and DC circuits.

8. Bushings and Bushing Current Transformers (BCT):

a. Bushing housings shall be ANSI 70 light gray polymer or porcelain. Porcelain bushings may be acceptable as an alternate and should be proposed as an alternate only after proposing polymer bushings.

b. Bushings shall have a minimum strike distance and a minimum leakage (creep) distance as specified below. The bushing BIL rating shall meet or exceed the breaker's BIL rating.

c. BCTs designated for protective relaying functions shall be typically 5-tap, multi-ratio, with full-winding ratios and accuracy as specified in Section E, Bushing Current Transformers. Each multi-ratio BCT with a primary current rating of 1200 Amps and higher shall be a Class 1 Instrument Transformer as defined by IEEE C57.13 with an accuracy class of C800, unless noted otherwise in Section E. Each multi-ratio BCT with a primary current rating of less than 1200 Amps shall be a Class 1 Instrument Transformer as defined by IEEE C57.13 with an accuracy class of C400, unless noted otherwise in Section E.

d. All BCT secondary leads associated with each pole and bushing shall be wired to 6-point short-circuiting type terminal blocks in the common control compartment. A separate terminal block, complete with shorting screws, shall be furnished by the Supplier for each BCT. BCT secondary leads shall be #10 AWG single conductor cables. BCT secondary leads shall not contain splices between the CT core/winding assembly and the shorting terminal blocks.

e. All BCTs shall have a minimum thermal rating factor of 2.0.

9. Accessories:

a. Each operating mechanism shall have an operations counter arranged to count each opening operation.

b. Each operating mechanism shall have a visual mechanical position indicator effectively connected to the operating mechanism. Green shall indicate open, and red shall indicate closed.

c. The Supplier shall provide an externally operable emergency trip mechanism equipped with an automatic lockout switch to prevent electrical reclosing. The emergency trip device shall be colored red

and prominently located on the exterior of the circuit breaker's compartment housing.

10. Paint and Finish:
    a. The following referenced surface preparation specifications of the Society of Protective Coatings (SSPC) shall form a part of this specification:
        1) Solvent cleaning (SSPC-SP1): Removal of oil, grease, soil, salts, and other soluble contaminants by cleaning with solvent, vapor, alkali, emulsion, or steam.
        2) Hand tool cleaning (SSPC-SP2): Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by hand chipping, scraping, sanding, and wire brushing.
        3) Power tool cleaning (SSPC-SP3): Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by power tool chipping, descaling, sanding, wire brushing, and grinding.
        4) White metal blast cleaning (SSPC-SP5): Removal of all visible rust, oil, grease, soil, dust, mill scale, paint, oxides, corrosion products and foreign matter by blast cleaning.
        5) Commercial blast cleaning (SSPC SP6): Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 33 percent of each square inch of surface area.
        6) Brush-off blast cleaning (SSPC-SP7): Removal of all visible oil, grease, soil, dust, loose mill scale, loose rust, and loose paint.
        7) Near-white blast cleaning (SSPC-SP10): Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 5 percent of each square inch of surface area.
        8) Marginally prepared surfaces (maintenance): Remove visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter in accordance with manufacturer's instructions.
    b. The control compartment exterior paint finish, and bushing housings shall be Munsell 5.0 BG 7.0/0.4 light gray. Supplier shall furnish one quart of touch-up paint per MVCB. Cast aluminum, aluminum, and stainless steel components shall be left in their natural finish.
    c. The control compartment interior shall be painted the Supplier's standard white (preferred) or gray paint finish color.
    d. All surfaces of the control compartment, covers, panels, etc., shall be thoroughly cleaned by degreasing and abrasive blasting to remove scale, rust, and corrosion (SSPC-SP2, -SP3, -SP5, -SP6, SP7, and -SP10). Oil and grease shall be removed chemically or with steam, and in accordance with the manufacturer's criteria (SSPC-SP1). Steel surface and fabrication defects shall be corrected. Weld splatter and slag shall be removed. Welded seams, undercuts, recesses, porous surfaces, weld flux, and sharp edges are to be finish to smooth and rounded surfaces. All surfaces shall be dry and then be given at least one primer coat within eight hours

to prevent the formation of rust. Vinyl, zinc-pigmented, or chlorinated rubber primers are unacceptable.

e. Prepare steel surfaces in accordance with manufacturer's criteria. Cast aluminum and stainless steel components shall be left in their natural finish.

f. After preparing the primed surfaces, all exterior surfaces shall be given two field coats in accordance with the manufacturer's instructions of an approved finish coating having an acceptable total dry-film finish thickness (DFT). The primer, intermediate, and finish coatings are to be compatible with one another and from the same coatings manufacturer. Electrostatically applied polyurethane powder paint is also acceptable if approved by UL for this application.

g. Mix and thin coatings, including multi-component materials, in accordance with manufacturer's instructions. Keep containers closed when not in use to avoid contamination, and do not use mixed coatings beyond pot life limits. Use application equipment, tools, pressure settings, and techniques in accordance with manufacturer's instructions. Uniformly apply coatings at spreading rate required to achieve specified DFT. Apply coatings to be free of film characteristics or defects that would adversely affect performance or appearance of coating systems. Ensure that edges, corners, crevices, welds, and similar areas receive film thickness equivalent to adjacent areas.

h. Apply coatings in accordance with manufacturer's instructions.

i. The Supplier shall furnish documentation to the OE regarding their standard system, and the OE will review and accept as appropriate. The Supplier will furnish one (1) can of matching paint to accommodate field touch-up. Field coating repairs are to be made in accordance with the manufacturer's instructions.

j. If the equipment's support frame is fabricated using mild steel, then the assembled frame shall be hot-dip galvanized. Support frames fabricated using aluminum or stainless steel may be left in their natural finish. An additional paint finish over the galvanized finish is not required.

11. Capacitance Switching Current:

a. The MVCB shall be capable of switching capacitive currents as defined for a Class C1 Circuit Breaker as identified by IEEE C57.04. Additionally, as applicable the breaker shall be rated to switch overhead line or underground cable charging current equivalent to ratings listed for a Class C1 Circuit Breaker as identified by IEEE C57.04 and corresponding to the Maximum Voltage listed in the PSD. The rated Transient Overvoltage shall correspond to the test duty indicated below for a system grounded through a wye-connected transformer with a neutral rounding resistor.

12. Medium Voltage Circuit Breaker Testing Procedure:

a. Factory tests shall include all tests identified as "Production" in IEEE C37.09. Additionally, any special or specific tests identified within this specification shall be performed by the Supplier. The Supplier will submit an Inspection and Test Procedure Outline to the Purchasing Authority for acceptance at least three weeks prior to the commencement of testing.

b. All test results, measurements, and calculated values shall be recorded on the Supplier 's Certified Test Report. All data within the

Certified Test Report shall be reviewed and accepted by the Purchasing Authority and their technical representative before the circuit breaker is shipped. All production and special factory tests may be witnessed by the Purchasing Authority's technical representative.

c. Any test results that are deemed to be "Not Acceptable" or a "Failure" by the Purchasing Authority's technical representative will require a detailed investigation prior to the performance of any remedial actions and/or retest.

d. The order of tests performed on the assembled breaker will generally be in accordance with IEEE C37.09, and as agreed to in the Inspection and Test Procedure Outline document. The order may be modified as special circumstances present themselves during testing.

e. Provide type test reports for the breaker bushings per the requirements of IEEE C57.19.00. Provide production test reports for the bushing current transformers per the requirements of IEEE C57.13.

f. Construction and Dimensional Checking: Measurements are to be made by the Supplier's Quality Control personnel of the construction (paint and weld conditions) and dimensional characteristics, noting any significant deviations from the approved outline drawings.

g. Notify Owner at least 6 weeks prior to tests as to when and where tests shall be performed.

h. Factory representative to be present during commissioning and sign off.

i. Owner will pay cost of observation.

C. Electrical Characteristics Medium-Voltage Circuit Breaker Ratings, Provisions, and Accessories: The MVCB shall be designed to industry standards, and include the following:

1. Power Frequency: 60 Hertz
2. Nominal Distribution System Voltage: 12.47 kV rms
3. Maximum Distribution System Voltage: 13.72 kV rms
4. Full Wave Lightning Impulse Withstand Voltage (BIL): 110 kV, peak
5. IEEE Application Class: S1 (Underground distribution system)
6. IEEE Cable/Line Application Class: T60
7. IEEE Capacitive Switching Application Class: C1 (Low probability of Restrike)
8. Power Frequency Withstand Voltage (1-Minute Dry): 50 kV rms
9. Power Frequency Withstand Voltage (10-seconds Wet): 45 kV rms
10. Chopped Wave Withstand Voltage (2-Microseconds): Not Required
11. Rated Continuous Current: 1200 A rms
12. Minimum Closing and Latching Current: 65 kA peak
13. Minimum Interrupting Current Rating: 25 kA rms
14. Rated Interrupting Time: 50 milliseconds
15. Minimum Cable Charging Switching Current: 25 A rms
16. Minimum Isolated Capacitive Switching Current: 630 A rms
17. DC Control Voltage: 48 V DC
18. AC Supply Power: 120/240 V AC single-phase
19. Mechanism Charging Motor Supply Power (when applicable): 120 V AC single-phase
20. Provide a secondary trip coil and separate trip circuit (Yes/No): No.

D. Physical Characteristics:
   1. Site Elevation: 1720 Feet above mean sea level
   2. Design – Extreme High Ambient Temperature: 47.2°C:
   3. Design – Extreme Low Ambient Temperature: -20.6°C
   4. Design – Highest Average Ambient Temperature within a 24-hour period: 34.3°C
   5. Minimum installed height from support base to energized bushing components: 115-inches
   6. Minimum installed height from support base to bushing non-grounded flange: 96-inches
   7. Minimum phase-to-phase pole spacing at the line terminal centerline: 13-inches
   8. Minimum metal-to-metal spacing between line terminals of the same pole: 16-inches
   9. Minimum installed height from base to bottom of common control compartment: 25-inches
   10. Supply with polymer (composite) bushings as the Base Proposal (Yes/No): Yes
   11. Supply with porcelain bushings as the Base Proposal (Yes/No): No
   12. Bushing minimum leakage distance: 28 inches
   13. Bushing minimum strike distance: 11 inches
   14. Minimum terminal loading tension (service load): 250 pounds-force
   15. Weathersheds color: light gray
   16. The minimum height to external parts shall be as indicated below, and in no case, be less than those specified by the NESC for the breaker's specific BIL.
   17. Except as required otherwise in this document, the wind and seismic withstand capability of the equipment shall be in complete accordance with the latest applicable industry codes, and IEEE standards in effect on the date of invitation to bid. These documents shall include, but shall not necessarily be limited to, IEEE 693, Recommended Practices for Seismic Design of Substations.

E. Bushing Current Transformers:
   1. Transformer-side (Bushings 1/3/5) bushing current transformers: one (1) three-phase set of 1200:5, C800, multi-ratio BCTs in the X-Position (nearest the interrupting contacts); and one (1) three-phase set of 1000:5, 0.15% @B0.9 single-ratio BCTs in the Y-Position.
   2. Load-side (Bushings 2/4/6) bushing current transformers: one (1) three-phase set of 1200:5, C800, multi-ratio BCTs in the X-Position (nearest the interrupting contacts); and one (1) three-phase set of 1200:5, C800, multi-ratio BCTs in the Y-Position.

F. Standard accessories:
   1. None

G. Optional accessories:
   1. None

H. Seismic Requirements (IEEE 693): 0.5 g acceleration (post-installation)

PART 3 - EXECUTION

3.1 QUANTITY REQUIRED

A. Two (2) three-phase units

3.2 INSTALLATION

A. Performed by others

3.3 FIELD QUALITY CONTROL

A. Performed by others

END OF SECTION