

**SECTION 26 13 20
MEDIUM-VOLTAGE RING MAIN UNIT****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. The section includes engineering design, manufacture, supply, installation, testing and commissioning of Medium Voltage Ring Main Unit (RMU) with the following optional components, features, and accessories:
1. Copper, tin-plated main bus.
 2. Communication modules.
 3. Analog instruments.
 4. Relays.
 5. Surge arresters.
 6. Provisions for future devices.
 7. Fungus proofing.
 8. Control battery system.
 9. Mimic bus.
- B. Install the Ring main unit outdoors or as a part of a Package Substation
- C. Ring main unit configuration and location of the works: as shown on drawings.
- D. Check the ratings and/or sizes of those components whose ratings and sizes are specified in the Contract documents. When this check indicates that the specified ratings and sizes are not adequate, make the necessary changes, after getting RC approval.
- E. The supply of materials and equipment shall include the following:
1. Sizing and application calculations for systems, components and verification of specified sizes and quantities.
 2. Preparation of system protection coordination studies.
 3. Preparation of installation detail drawings including the concrete pad.
 4. Preparation of commissioning and start-up manuals.
 5. Special tools required for the initial installation and future maintenance.
 6. List of Recommended Operational Spare Parts along with the breakdown price list.

- F. The installation of ring main unit shall include the following:
1. Implementation of manufacturer's standards and otherwise specified quality control, inspection and testing procedures.
 2. Commissioning and energization of the ring main unit and related equipment.
 3. Preparations of "As-Built" drawings including revision of existing interface drawings (originals) to "As-built" condition.
- G. The design, including configuration of switchgear, protection, and monitoring systems and equipment shall follow the precedence of existing "like" systems.

1.3 DEFINITIONS

- A. NRTL: Nationally Recognized Testing Laboratory.
- B. RMU: Ring Main Unit.

1.4 SUBMITTALS

- A. Product Data: For each type of switchgear and related equipment, include the following:
 1. Rated capacities, operating characteristics, furnished specialties, and accessories for individual interrupter switches and circuit breakers.
 2. Time-current characteristic curves for overcurrent protective devices corrected for ambient temperature specified.
- B. Shop Drawings: For each type of switchgear and related equipment, include the following:
 1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show method of field assembly and location and size of each field connection. Include the following:
 - a. Tabulation of installed devices with features and ratings.
 - b. Outline and general arrangement drawing showing dimensions, shipping sections, and weights of each assembled section.
 - c. Drawing of cable termination compartments showing preferred locations for conduits and indicating space available for cable terminations.
 - d. Floor plan drawing showing locations for anchor bolts and leveling channels.
 - e. Current ratings of buses.
 - f. Short-time and short-circuit ratings of switchgear assembly.
 - g. Nameplate legends.

- h. Detailed drawings of rating nameplates
 - i. Painting system details.
 - j. Cable termination details.
 - k. Utility company's metering provisions with indication of approval by utility company.
2. Design Calculations: Signed and sealed by a qualified engineer.
- a. Calculate requirements for selecting seismic restraints.
 - b. Protective device settings and coordination study from the source bus in substation.
3. Wiring Diagrams: For each type of switchgear and related equipment, include the following:
- a. Power, signal, and control wiring.
 - b. One-line and Three-line diagrams of current and future secondary circuits showing device terminal numbers and internal diagrams.
 - c. Schematic control diagrams.
 - d. Diagrams showing connections of component devices and equipment.
 - e. Grounding details
4. Foundation plan and installation details
- C. Coordination Drawings: Floor plans showing dimensioned layout, required working clearances, and required area above and around switchgear where piping and ducts are prohibited. Show switchgear layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Identify field measurements.
- D. Manufacturer Seismic Qualification Certification: Submit certification that switchgear, accessories, and components will withstand seismic forces defined in Section 26 05 48 "Vibration and Seismic Controls for Electrical Systems." Include the following:
- 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- E. Qualification Data: For professional engineer and testing agency.

- F. Commissioning procedures and test forms.
- G. Source quality-control test reports.
- H. Field quality-control test reports.
- I. Operation and Maintenance Data: For switchgear and switchgear components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - 2. Time-current curves, including selectable ranges for each type of overcurrent protective device.
 - 3. Incorporate source quality and field quality test reports into the Operation and Maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a NRTL as defined by OSHA in 29 CFR 1910.7.
- B. Source Limitations: Obtain each type of switchgear and associated components through one source from a single manufacturer.
- C. Product Options: Drawings indicate size, profiles, and dimensional requirements of switchgear and are based on the specific system indicated. Refer to Section 01 60 00 "Product Requirements."
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- E. Comply with the latest edition of the following applicable Standards and Codes:
 - 1. IEEE C2
 - 2. IEC 60056 High-voltage alternating-current circuit breakers
 - 3. IEC 60129 Alternating current disconnections (isolators) and earthing switch
 - 4. IEC 60255 Electric Relays
 - 5. IEC 60265 High-voltage switches
 - 6. IEC 60282 High-voltage fuses
 - 7. IEC 60298 AC metal-enclosed switchgear and control gear for rated voltage above 1 kV and up to and including 52 kV
 - 8. IEC 60337 Control switches (low-voltage switching devices for control and auxiliary circuits, including contactor relays)
 - 9. IEC 60376 Specification and acceptance of new sulfur hexafluoride

10. IEC 60420 High-voltage alternating current fuse-switch combination and fuse circuit-Breaker combination
11. IEC 60529 Classification of degree of protection provided by enclosures
12. IEC 60694 Common specifications for HV switchgear and control gear standards
13. ISO 2063 Metallic coatings – protection of iron and steel against corrosion Metal spraying of Zinc and Aluminum
14. DIN 43625 High voltage fuses; rated voltages 3.6 kV to 36 kV; fuse-link

1.6 WARRANTY

- A. The vendor shall warrant the ring main unit against all defects arising out of faulty design or workmanship or defective material for a period of two years from the date of delivery.
- B. Warranty period for gas tightness shall conform to clause 5.15.3 of IEC 60694. Manufacturer shall assume full responsibility for no gas leakage during the service life. In case of gas leak during the service life, all expenses for repairs and replacements provided by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver in sections of lengths that can be moved past obstructions in delivery path as indicated.
- B. Store switchgear indoors in clean dry space with uniform temperature to prevent condensation. Protect switchgear from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- C. If stored in areas subjected to weather, cover switchgear to provide protection from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside switchgear; install electric heating (250 W per section) to prevent condensation.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation at indicated ampere ratings for the following conditions:
 1. Altitude of less than 1000 meters above sea level.
 2. Outdoor design temperature: 50 C Max.
 3. Surface temperature (direct sun exposure): 80 C Max.
 4. Humidity: 100% Max.
 5. Blowing sand size: 0.5 to 50 microns
 6. Atmosphere: Salt spray.
 7. Outdoor average temperature (24 hour period): 40C

8. For complete information about site conditions, see the Royal Commission General Design Criteria and Technical Guidelines.
- B. Installation Pathway: Remove and replace building components and structures to provide pathway for moving switchgear into place.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchgear, including clearances between switchgear and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- D. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
 1. Notify Construction Manager and Owner no fewer than 30 days in advance of proposed interruption of electrical service.
 2. Do not proceed with interruption of electrical service without Construction Manager's and Owner's written permission.

1.9 COORDINATION

- A. Coordinate layout and installation of switchgear and components with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required clearances for workspace and equipment access doors and panels.
- B. Coordinate size and location of concrete bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.10 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Fuses: Six of each type and rating used. Include spares for future transformers, control power circuits, and fusible devices.
 2. Indicating Lights: Six of each type installed.
 3. Touchup Paint: Three containers of paint matching enclosure finish, each 250 mL.
- B. Maintenance Tools: Furnish tools and miscellaneous items required for interrupter switchgear test, inspection, maintenance, and operation. Include the following:

1. Fuse-handling tool.
2. Extension rails, lifting device, transport or dockable dolly or mobile lift, and all other items necessary to remove circuit breaker from housing and transport to remote location.
3. Racking handle to move circuit breaker manually between connected and disconnected positions, and a secondary test coupler to permit testing of circuit breaker without removal from switchgear.

PART 2 - 1.1 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements.
1. Firms regularly engaged in manufacture of medium-voltage ring main unit, sizes and ratings required, whose products have been in satisfactory use in similar service for not less than 10 years. Preference shall be given to local manufacturers and agents/suppliers.

2.2 MANUFACTURED UNITS

- A. Description: Factory assembled and tested, and complying with IEEE C37.20.1.
- B. Ratings: Suitable for application in 3-phase, 3-wire, 60-Hz, low resistance grounded-system.
- C. System Voltage: 13.8 kV nominal; 15 kV maximum

2.3 RING MAIN UNIT REQUIREMENTS

- A. 15KV Ring Main Unit requirements:
1. Rated System Nominal Voltage: 13.8kV
 2. Rated Maximum System Voltage: 15.5kV
 3. Rated Power Frequency Withstand (1 minute): 38kV (rms)
 4. Rated Lightning Impulse Withstand (1.2x50 μ s): 95kV (peak)
 5. Rated Main Bus Continuous Current (MIN): 600A
 6. Rated Continuous Current and Rated Load and Loop Interrupting Current:
 - a. Main Loop Switches: 600A
 - b. Tap (Lateral Loop) Switches: 600A, 400A or 200A
 7. Rated Short Circuit Current (1 second sym): 20kA
 8. Fault Close and Latch Current (asymmetrical): 31kA
- B. Ring main unit:

1. Compartmental type, designed, assembled and wired at the factory as an integral unit. Provide complete unit from incoming line terminals to the outgoing feeder terminals.
2. Indoor or Outdoor type
3. Comprised of two (2) 600A load break disconnect main switches for the main loop, and one (1), two (2) or three (3) 600A, 400A or 200A load break fused disconnect tap switches for lateral loops.
4. Configuration and minimum ratings: as specified and shown on drawings.
5. Terminals: suitable cable size indicated on the drawings.
6. Group the live parts of the switchgear and bus bars assembly together in a gas tight stainless steel chamber filled with SF6 gas, and sealed for life.

C. Ring switches:

1. Manually operable load break and fault-making type: capable to interrupt full rated current, small inductive or capacitive currents involved in disconnecting of unloaded transformers and cables. Suitable for full fault-making current.
2. Three-positions: 'ON', 'OFF', and 'Earth'.
3. Two independent manual operating mechanisms for ring and earth switches are also acceptable. Open-closed SF6 complete with grounding switches integral to Ring main unit. Switches must remain operable after closing into the rated fault current.
4. SF6 switch assemblies shall have the following features:
 - a. ON-OFF-EARTH position for each switch.
 - b. Warning sign near operating handle of each main loop switch, engraved 'WARNING OPEN OTHER END OF LINE BEFORE OPERATING TO EARTH POSITION.'
 - c. Contact viewing window for each switch.
 - d. Pressure gauge showing the safe operating pressure over temperature range.
 - e. Fill valve.

D. Tee-Off Circuit Protection: fuse switch or circuit breaker.

1. Fuse Switch:
 - a. Capable to interrupt full rated current as stated above, by blowing of a fuse(s) or by actuating a push button, which shall cause simultaneous tripping of all phases.
 - b. Manually closed by means of an operating handle and independent fast acting operating mechanism. Closing movement charges the opening mechanism, for opening by 'trip' push button operation.
 - c. Closing speed of the switch: independent of the speed with which the operating handle is moved.
 - d. Tee-off switch shall consist of a moving contact assembly with three positions; 'ON', 'OFF', and 'Earth'. Two independent manual operating mechanisms for tee-off switch and earth switch are also acceptable. Design the earth switch contacts to close into a fault and with the same short circuit capacity as the main contacts.

- e. Tee-off switch shall also be suitable to equip with shunt trip coil, rated for 230 V AC. Provide if specified in contract drawing.
 - f. Suitable to accommodate three HRC fuses, in individually sealed chambers.
 - g. Fuses:
 - 1) DIN-type with striker pin and fuse link length of 442 mm. Provide single phase protection.
 - 2) Blown fuse shall automatically disconnect all three phases to prevent single phasing.
 - 3) Select standard ratings based on coordination study.
 - 4) Self-contained current limiting type operating during the first quarter cycle on maximum fault condition to provide fast interruption with minimum let-through current.
 - 5) Fuse operation: no expulsion of gases or foreign matter from the tube.
 - 6) Field replaceable.
2. Circuit Breaker:
- a. SF6 or Vacuum type capable to interrupt full rated fault current and full fault making current.
 - b. Opening of the circuit breaker: local manual trip button, or by protective relay circuit or by remote tripping signal.
 - c. Closing movement charges the opening mechanism, of the circuit breaker.
 - d. Provide earthing of tee-off circuit s by an off load isolator switch having the same fault make capacity as the Ring switches.
 - e. Provide fast acting operating mechanism independent of the operator action with three positions;
 - 1) circuit breaker 'ON',
 - 2) circuit breaker and isolator 'OFF'
 - 3) earthing switch 'Earth'
 - f. Circuit breaker operating mechanism shall have provision for on-site installation (retrofitting) of geared motor mechanism and associated closing and opening coils with necessary contactors for remote and future telemetry control operations in the distribution network.
 - g. Protective Relay: use self-powered protective relay with over-current and earth fault protection on tee-off circuit:
 - 1) Phase and Ground Over current Protective Relays with Low set (Time Delay) and High-set (Instantaneous) Elements (50/51,50N/51N) for RMUs
 - 2) Microprocessor based numerical type.
 - 3) Components, hardware, input/output devices of the relay shall comply with relevant IEC or equivalent standards.
 - 4) The relay shall use thoroughly tested software and hardware to IEC or equivalent standards. Relay should have acquired at least two (2) years of field experience in a major electric utility.

- 5) Input/output units: capable of making/breaking currents (with any transients) and withstand voltages (normally intended/harmonic over voltages).
- 6) Immune to all types of electrical and mechanical interference in accordance with relevant IEC standard.
- 7) Self-powered from RMU CTs or provided with its own power supply (Relays requiring external power supply are not acceptable).
- 8) The degree of protection of the relay enclosure: class IP 54 or better.
- 9) Provide suitable relay for outdoor installations in extreme heat and dust conditions without affecting its normal performance.
- 10) The relay shall consist of three (3) 1-phase over current unit and one (1) ground fault unit and suitable for 5A or 1A CT secondary current.
- 11) Each phase and ground unit shall consist of Low-set (Time Delay) element and High-set (Instantaneous) element.
- 12) Low-set (Time Delay) element of both phase and ground fault units shall have:
 - a) Selectable inverse time characteristics according to IEC 60255 or BS142.
 - b) Selectable pickup setting.
 - c) Selectable time multiplier setting.
 - d) High-set (Instantaneous) element of the phase and ground units shall have:
 - e) Separate target.
 - f) Selectable setting.
 - g) Provision to disable the element through front panel commands/settings or software.
- 13) The relay shall have:
 - a) Low-set Phase Over current Relay Pickup range: 30% to 240% of relay rated current in steps of 10%.
 - b) Low-set Ground Over current Relay Pickup range: 10% to 100% of relay rated current in steps of 10%.
 - c) Time multiplier range of 0.1 to 1.2s for the phase and ground over current in steps of 0.05.
 - d) High-set Phase over current relay pickup range: 100% to 3200% of relay rated current in steps of 50%
- 14) Provide with high intensity LED target indicators for the low-set and high-set elements
- 15) The relay AC circuits shall withstand continuous current of $3xIn$ (where In is the relay rated current), a current of $20xIn$ for 10 sec. and a current of $70xIn$ for 1 sec.
- 16) The relay shall have high dropout to pickup ratio and transient overreaching for instantaneous unit less than 5%. The relay shall impose low burden on CTs.

17) Provide compatible relay and CTs.

E. Operating positions: display on a mimic diagram on the front of the unit the position of each of the switches. Provide clear indicators showing 'ON', OFF' and 'Earth' on polycarbonate or metal painted labels not less than 15 mm in height and 1.5 mm thick (sticker type labels are not acceptable). Provide indicator windows not less than 15 mm in diameter and covered with transparent UV resistant material with adequate mechanical strength.

| Indicator | Letters | Background |
|-----------|---------|------------|
| ON | White | Red |
| OFF | White | Green |
| Earth | Black | Yellow |

F. Operating mechanisms:

1. Accessible by removing the front plate.
2. Operating handle: anti-reflex action, store at the front of the unit.
3. Common operating handle: use for all operations of both ring and tee-off switches.
4. Operating handle inserts shall have markings as appropriate to avoid inserting the wrong end during switching operations.
5. Physical effort required for operating any mechanism shall not exceed 400 N.
6. Provide padlocking provisions in order to prevent unauthorized access for the operation of ring main unit, operating Handle entries for ring & tee-off switches and trip push button. Provide for padlocks having 6 mm shackle with 24 mm clearance. Provide the Padlocking provision material that is adequately strong and compatible with the life of unit.

G. Cable Testing Facility: test bushings or test probe insertion facility for high voltage and current injection tests for the cables terminated on ring switches. Disconnection of cables for testing purposes is not acceptable.

H. Provide Interlocks to make the following operations impossible:

1. The operation of a ring switch or fuse switch/circuit breaker directly from 'ON' to 'Earth' or from 'Earth' to 'ON'.
2. The following additional requirements apply if the unit offered has two independent manual operating mechanisms for ring and earth switches:
 - a. Operation of the 'Earth ON / Earth OFF' mechanism of earth switch unless the 'ON/OFF' mechanism of ring switch is in the 'OFF' position.
 - b. Operation of the 'ON/OFF' mechanism of ring switch unless the 'Earth ON / Earth OFF' mechanism of earth switch is in the 'Earth OFF' position.
3. Opening of the cable test cover without the associated ring switch or fuse switch / circuit breaker being in the 'Earth' position.

4. Closing ring switch or fuse switch / circuit breaker to 'ON' with the test plug inserted and /or the cover open.
 5. Insertion or withdrawal of the test plugs with the switch in any position other than 'Earth' position.
 6. Fuse changing from the fuse switch in any position other than 'Earth' position.
 7. Closing fuse switch to 'ON' where as:
 - a. The fuse access cover not properly closed
 - b. Fuse switch in 'Earth' position
 - c. Fuse holder not correctly in position
 - d. Any fuse blown
 8. Opening of cable boxes without the associated ring switch in the 'Earth' position.
 9. Mechanical interlocks between circuit breaker and disconnect switch (DS) and earth switch (ES).
 10. Mechanical interlock between circuit breaker and cable cover.
- I. Internal arc proof capacity: not less than 20kA 1 sec (SF6 tank).
- J. Terminals and Cable Boxes:
1. Each 600A main switch shall have stud bushings or cable box capable of bolting three (3) 300 mm² XLPE cables per phase terminated with lugs.
 2. Elbow type terminations shall not be used for main switches.
 3. Tap switches can have either stud bushings or bushing wells for elbow type terminations for one (1) XLPE cable 70mm² to 150mm².
 4. Cable terminations: as specified in Section 260513.
 5. Bushings and cable terminations shall withstand the maximum fault closing specified. Provide adequate space to allow termination and support for cables.
 6. Terminate cables using single-hole cable lugs suitable for bolt size as specified in section 260513. Provide cable termination by means of bolted connection on cable bushing with heat/cold shrinkable insulating or screened premolded right angle/straight boots. Provide sufficient clearance in the ring and tee-off cable boxes for cable termination by heat shrink application.
 7. Provide suitable bushings for ring and transformer switches for bolted type connections with heat/cold shrinkable or pre-molded termination with separable elbow connectors. Equip the bushing with a stud having an exposed part for ring and for transformer connection complete with nuts and washers.
 8. Provide suitable vertical distance from the top of cable clamp to the centerline of cable bushings for all types of terminations.
 9. Provide removable cable box cover and sidewalls for full access during cable termination at the cable box.

- K. Bus bars: copper with either welded or silver plated bolted connections. Provide a ground bus complete with provision for connection of two 120mm² ground copper conductors at each end.
- L. Overall maximum size of the ring main unit:
- | | 3-Way | 4-way |
|--------------------------------------|---------|---------|
| Height (H) | 1600 mm | 1600 mm |
| Width (W) | 1500 mm | 1670 mm |
| Depth (D) | 1100 mm | 1100 mm |
| Operating mechanism height (maximum) | 1300 mm | 1300 mm |
- M. Provide ring main unit that is suitable for mounting on Royal Commission Standard foundation.
- N. Earthing: ground bar of not less than 25 x 5 mm copper strip bolted to the frame. Locate it to facilitate earthing of cable sheaths and earthing devices.
- O. Voltage Indicator Lamps/Phase Comparators: Built-in or Push-button type neon voltage indicators provided together with low voltage hot phasing facility on ring switches. Power the lamps using bushing type capacitive dividers.
- P. Internal wiring in cable boxes: protect with heat resistant tape/tube, against flame temperatures of gas torch during cable termination.
- Q. Earth Fault Indicator (EFI):
1. RC approved type with automatic resetting on 220-230V single phase AC supply. Provide split core type sensor of internal diameter not less than 130 mm.
 2. Protect inside separate sunshield cover with a mesh front (drawn from the same metal sheet).
 3. Install EFI on the left-hand side line-feeder.
 4. Provide Three-pin plug for testing of EFI by primary current injection in separate compartment with screwed cover below the EFI housing.
- R. SF6 Gas Pressure Indicator & Refilling Provision:
1. Temperature independent gas pressure gauge marked with green (safe) and red (not safe) zones.
 2. The safe operating zone shall correspond to a temperature range of – 100C to 500C.
 3. The unit shall continue to work safely even if the gas pressure inside the tank goes down to the atmospheric pressure.
 4. Refilling/re-pressurizing inlet valve: easily accessible for field refilling.
- S. Over-pressure Release: RMU shall withstand any overpressure due to an internal fault by rupture of a gas escape membrane located at the rear or bottom of the enclosure. Release the gas out through a flap in the rear panel to the bottom of the enclosure.

- T. Provide Switch handles, nameplates, hinges and hardware of stainless steel, bronze or other equivalent corrosion resistant material. Provide no exposed screws, bolts or other fastening devices which are externally removable. Provide no opening through which sticks, rods and wires might be inserted.
- U. Access doors shall use 3-point latching mechanisms, concealed hinges and shall close tightly to prevent ingress of dust and blowing rain. Gasketing material shall withstand 10 C to 80 C temperatures without deterioration. Provide each door with a padlock and common master key.
- V. The degree of protection: IP54 or better as specified in IEC 60529.
- W. Provide a central handle, locking bar, handle integral lock and pad locking provision as required by RC standards.
- X. Provide standard means for lifting, jacking or rolling.

2.4 IDENTIFICATION

- A. Materials: Refer to Section 26 05 53 "Identification for Electrical Systems." Identify units, devices, controls, and wiring.
- B. Interior labels: non-corrosive metal or laminated rigid plastic.
- C. Exterior labels: metal with a vitreous enamel or porcelain finish or fiberglass with non-fading lettering.
- D. Rating Nameplate and diagram plate: non-corrosive metal.

2.5 SOURCE QUALITY CONTROL

- A. Before shipment of equipment, perform the following tests and prepare test reports:
 1. Perform complete factory tests on Ring Main Unit in accordance with IEC 60420, 60265, 60056, and 60529.
 2. Fuses: test in accordance with IEC 60420.
 3. The Ring Main Unit shall not be shipped unless results of tests show compliance with all requirements of this Specification.
 4. The Royal Commission reserves the right to witness tests. Provide written notification to the Royal Commission at least eight (8) weeks in advance of test date. The notice shall include an outline of the procedures to be used in performance of tests. This outline shall include a brief description of the test equipment, connection diagrams, proposed test sheets, calculations

and minimum/maximum test and performance values which will be used to determine conformance with the specification and applicable standards.

5. Do not proceed with the tests until the Royal Commission representative arrives or until he has received written notification that the Royal Commission has elected to waive witnessing a particular test.

B. Assemble switchgear and equipment in manufacturer's plant and perform the following:

1. Functional tests of all relays, instruments, meters, and control devices by application of secondary three-phase voltage to voltage circuits and injection of current in current transformer secondary circuits.
2. Functional test of all control and trip circuits. Connect test devices into circuits to simulate operation of controlled remote equipment such as circuit-breaker trip coils, close coils, and auxiliary contacts. Test proper operation of relay targets.

C. Prepare equipment for shipment.

1. Provide suitable crating, blocking, and supports so equipment will withstand expected domestic shipping and handling shocks and vibration.
2. Weatherproof equipment for shipment. Close connection openings to prevent entrance of foreign material during shipment and storage.

2.6 FACTORY FINISHES

- A. Surface treat and bonderize before painting the enclosure and all compartments.
- B. The interior finish paint color of non-stainless steel surfaces: per RC standards.
- C. Exterior carbon sheet steel enclosure:
 1. Corrosion resistant marine coating factory finish with a painting system to provide durability with no system breakdown and color fading for a minimum period of 10 years. A manufacturer's statement to this effect is required.
 2. Finish color: Munsell Green #7 GY 3.29/1.5.
- D. Stainless steel finish: natural.
- E. Undercoat the recessed bottom and 50mm up on all sides with coal tar epoxy.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive switchgear for compliance with requirements for installation tolerances, required clearances, and other conditions affecting performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install ring main unit in accordance with manufacturer recommended practices and applicable standards and per the approved design and shop drawings.
- B. Locate Ring main unit to allow sufficient working space and to operate a 2m long hot stick.
- C. Construct ring main unit foundation pad in accordance with these specifications and the RC Standard drawings coordinated with ring main unit shop drawings. Top of pad not less than 150 mm above finished grade. Adjust the size of the concrete pad to allow 150mm clear all around the switchgear assembly.
- D. Support and connect primary cables to the ring main unit bushings. Provide grounding rods and cables per Section 260526. Connect ground cables and cable shields to ring main unit ground bus.
- E. Install fault indicator sensors on cables.
- F. Seal the enclosure interface with the concrete pad to prevent ingress of water and dust.
- G. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchgear units and components.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Section 26 05 53 "Identification for Electrical Systems."
- B. Diagram and Instructions:
 - 1. Frame under clear acrylic plastic on front of switchgear.

- a. Operating Instructions: Printed basic instructions for switchgear, including control and key-interlock sequences and emergency procedures.
 - b. System Power Riser Diagrams: Depict power sources, feeders, distribution components, and major loads.
- C. Provide rating nameplate information stenciled for readability. Mount the rating nameplate on the inside back of compartment door. Provide nameplate with the following information indelibly marked in Arabic and English :
- 1. Manufacturer's Name
 - 2. Country of Origin
 - 3. Type/Model
 - 4. Vendor's Name
 - 5. Reference of RC specification
 - 6. Manufacturer's Serial Number
 - 7. RC Purchase Order Number
 - 8. RC Item Number
 - 9. Year of Manufacture
 - 10. Voltage Rating: kV
 - 11. Current Rating: Amps
 - 12. BIL: kV
 - 13. Short Circuit Rating / Duration: kA / Sec
 - 14. Rated Frequency: 60Hz
 - 15. Rated Making Current: kA
 - 16. Rated Breaking Current : kA
 - 17. Breaking capacity of transformer magnetizing: Amps
 - 18. Breaking capacity of capacitor current: Amps
 - 19. Gross Weight: kg
- D. Provide diagram plate showing the Ring Main Unit assembly in one line format mounted near the rating nameplate. Show switch configuration, terminal identification and appropriate reference drawing numbers. Stencil information in Arabic and English.
- E. Where required, labels for danger, caution, and warning and for special or non-standard operating instructions inscribed with both Arabic and English.
- F. Danger, caution and warning labels shall have red lettering on a white background. Special or non-standard operating instruction labels shall have black letters on a white background.
- G. Mount equipment identification label adjacent to the nameplate. The label shall show the purchase order number and the Royal Commission project number.
- H. Affix nameplates and labels using non-corrosive metal fasteners.

- I. In addition to manufacturers' standard nameplate, identify the ring main unit as per Royal Commission equipment designation, detail of which will be furnished after the award of the contract.
- J. The ring main unit shall have its unique tag number and connecting equipment numbers painted/stenciled on the enclosure.
- K. Identify incoming and outgoing circuits with cable tags.

3.4 CONNECTIONS

- A. Cable terminations at switchgear are specified in Section 26 05 13 "Medium-Voltage Cables."
- B. Tighten bus joints, electrical connectors, and terminals according to manufacturer's published torque-tightening values.
- C. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" and Section 26 05 13 "Medium-Voltage Cables."

3.5 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 - 1. Test insulation resistance for each switchgear bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:
 - 1. Inspect switchgear, wiring, components, connections, and equipment installation. Test and adjust components and equipment.
 - 2. Assist in field testing of equipment including pretesting and adjusting of automatic power factor correction units.
 - 3. Report results in writing.
- C. Perform the following field tests and inspections and prepare test reports:
 - 1. Perform each electrical test and visual and mechanical inspection stated in IEC and manufacturer testing documents. Certify compliance with test parameters.
 - 2. Relay Testing

- a. The relays shall be tested in accordance with the requirements of IEC or equivalent ANSI or British Standards.
 - b. The relays shall be capable of being functionally tested completely, with adequate safety without the risk of spurious tripping, per standard test connections, using secondary injection test sets.
 - c. The relay shall have external testing facilities. The design of the test terminals/plugs shall be such that external test equipment can be connected at a conveniently located connector on the relay panel.
3. Perform tests and checks on installed equipment and installations prior to commissioning. Perform tests and checks in accordance with approved test procedures that conform to applicable standards referenced in this Specification.
 4. Tests are subject to witnessing by Royal Commission representative.
 5. Provide test equipment.
 6. Submit test procedures to the Royal Commission for approval at least 8 weeks prior to testing. Test procedures shall include test descriptions, test equipment descriptions, test sheets, calculations and minimum/maximum test and performance values to be used in determining the acceptability of the equipment.
 7. Upon completion of testing, submit four copies of certified report attesting that each test was performed in accordance with the approved test procedures. The report for each test shall include the date of performance and name of the person in charge of the test.
- D. Remove and replace malfunctioning units and retest as specified above.

3.6 ADJUSTING

- A. Set field-adjustable, protective-relay trip characteristics according to results in Section 26 05 73 "Overcurrent Protective Device Coordination Study."

3.7 CLEANING

- A. On completion of installation, inspect interior and exterior of switchgear. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair damaged finishes.

3.8 PROTECTION

- A. Temporary Heating: Apply temporary heat to switchgear, according to manufacturer's written instructions, throughout periods when switchgear environment is not controlled for temperature and humidity within manufacturers stipulated service conditions.

3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain switchgear. Refer to Section 01 79 00 "Demonstration and Training."

END OF SECTION 26 13 20