

## TECHNICAL SPECIFICATION FOR SUPPLY OF 11KV Motorized RMUs

### 1.0 SCOPE:

The specification covers Design, manufacturing, pre dispatch testing and delivery of 11KV Motorized RMUs in accordance with the technical requirements mentioned in the specification and relevant standards.

### 2.0 STANDARDS:

- a) The equipment delivered shall be new and of high quality, suitable for the purpose it is intended for, free from defects and imperfections and of the classifications listed herein, or their equivalents, subject to acceptance by the Owner.
- b) The bidding shall be done by original equipment manufacturers only as specified in the bid.
- c) The offered units shall be in service for a minimum period of 5 years, reference list shall be provided in such cases.
- d) Materials used in the manufacture of the specified equipment shall be of the kind, composition and physical properties best suited to their various purposes and in accordance with the best engineering practices.
- e) The equipment design shall be suitable to render satisfactory operation under the conditions prevailing at site, and the equipment shall operate satisfactorily under normal load and voltage variations and frequency variations (50 c/s  $\pm$  3%) ensuring the safety, further include all necessary provisions ensuring the safety of the operating and maintenance personnel.
- f) The applicable standards of various equipment for the project is as specified here below:

#### 2.1 11kV 3 way Ring Main units

Description	Standard
<b><u>11kV 3 way Ring Main units</u></b>	
AC metal enclosed switchgear and control gear for rated voltages above 1 kV and up to and including 52 kV	IS 3427
Classification of degrees of protection provided by enclosures of electrical equipment	IS 12063
High Voltage Switches	IS 9920 (Parts 1 to 4)
Specification for AC disconnectors and earthing switches for voltages above 1000 V	IS 9921 (Parts 1 to 5)
HV AC Circuit Breakers	IS 13118
Dimensions of terminals of HV Switchgear and Control gear	IS 10601
General requirements of switchgear and control gear for voltages exceeding 1000 V	IS 12729
High voltage/Low voltage prefabricated substations	IEC 1330

PROJECT:RUBEK BALLOONS	Specification: <b>RMU</b>
------------------------	------------------------------

Description	Standard
Common clauses for MV switchgear standards	IEC 62271-100/200
Monitoring and control	IEC 6081
Current Transformers	IS 2705
Voltage transformers	IS 3156
Specification for Static Protective Relays	IS 8686
Standards for high voltage metal clad switchgear up to 52 KV.	IEC 62271-200

## **2.2 Key RMU Configurations of RING MAIN UNIT**

- Both side extensible Motor operated load break switches (LBSs) with earthing switches in SF6 and vacuum circuit breaker with Electrical closing and tripping along with disconnecter and earthing switches. The Battery charger along with batteries

### **1. Configuration (1 Iso+ 2 Brk)**

1 - 630 Amp triple pole, single break, 3 position (ON, OFF & EARTH) ring main switches, each with independent Motorized charged spring mechanism and fully rated earth switch, with provision for earthing and testing of the cable.

1 - Air insulated cable boxes with gland plate suitable for a bottom entry 3 core cable up to 300 sq. mm.

2 – 630 Amp triple pole, vacuum circuit breaker with independent motor charged spring mechanism and fully rated earth switch with provision for earth of the cable.

2 - Air insulated cable box with gland plate suitable for a bottom entry 3 core cables up to 300 sq. mm.

The unit will comprise of following:

- 1 - Mimic diagram on front panel complete with status indicators,
- 1 - Set of positive standard mechanical interlocks,
- 1 - Set of current transformers for protective relays with ratio 40/1A CL5P10
- 1 - Self powered relay: C&S/ Ashida /reputed equivalent,
- 1 – Sets of Motorised kit for Ring Switches & Circuit Breaker
- 1 – Set of Battery, 2x12V,
- 1 – Battery Charger 230V AC I/P, 24V DC O/P,
- 1 - Set of fully interlocked test access covers.
- 1 - Set of VPIS for ring isolator switches & Circuit breaker
- 1 - External stud for earthing connections
- 1 - SF6 gas pressure indicator and SF6 recharging facility
- 1 - Local 'PULL TO TRIP' mechanism suitably shrouded in each breaker.
- 1 - Set of auxiliary terminals
- 1 - Operating handle
- 3 - Set of Right angle boots.
- 1 – Earth Fault Indicator

**IO List****Digital Inputs for ISOLATOR**

Isolator Open  
 Isolator Closed  
 Earth Switch Open  
 Earth Switch Closed  
 FPI operated  
 Local / Remote Switch position

**Digital Outputs for ISOLATOR**

Isolator Close  
 Isolator Open  
 FPI Reset

**Digital Inputs for BREAKER**

Circuit Breaker ON  
 Circuit Breaker OFF  
 Earth Switch Open  
 Earth Switch Closed  
 Local / Remote Switch position

**Digital Outputs for BREAKER**

Circuit Breaker Close  
 Circuit Breaker Open

**3.0 RATINGS:**

The Protection and control unit range shall be designed to accommodate the control power supply voltages of 24 V DC voltage.

**4.0 Technical parameters****11 KV 3 Way RMU****4.1 Scope of Work**

- The Package scope of work shall include design, manufacture, testing, delivery installation commissioning of new Ring Main Units
- Where relevant, the RMU scope of work shall be coordinated with the work to be carried out like providing of UG cable under the project's other construction packages.
- Each RMU shall include its own power supply unit ( batteries, and battery charger), which shall provide a stable power source for the RMU.
- Each new RMU shall be equipped with main-line load break switches and a fault passage indicator (FPI). Furthermore, to protect each of its lateral / transformer

feeders, it shall be equipped with a corresponding set of circuit breakers and self-powered numerical relays.

#### **4.1.1 Environmental Conditions**

All materials supplied shall be capable of operating under relevant environmental conditions are listed as follows:

- Maximum ambient air temperature: - 45 °C
- Minimum ambient air temperature: - 0 °C
- Average ambient air temperature : - 40 °C
- Maximum relative humidity: - 0-100 %
- Average thunder storm days per annum: - 10
- Average rainfall per annum: - 400 mm
- Maximum wind speed: - 119 km/hr
- Altitude above mean sea level: - 1000 m

#### **4.1.2 Distribution Network Electrical Parameters**

The main parameters of the distribution network are as follows:

- Nominal system voltage: - 11 kV (rms)
- Highest system voltage: - 12 kV (rms)
- Number of phases: - 3
- Frequency: - 50 Hz
- **Variation in frequency:** - **50 ±3% Hz**
- Type of earthing: - Solid
- Power frequency withstand voltage: - 28 kV rms
- Basic impulse withstand voltage: - 75 kV peak

#### **4.1.3 Testing**

The specified RMUs shall be subject to type tests, routine tests, and acceptance tests. Where applicable, these tests shall be carried out as per the standards stated above.

#### **4.1.4 11 KV 3 Way RMU TECHNICAL PARAMETERS**

4.1.4.1 The scope of supply is supply 11 kV 3 Way RMU suitable for indoor application.

4.1.4.2 The RMU to be supplied shall be compact and shall meet the following requirements:

- Easy to install
- Safe and easy to operate
- Compact
- Low maintenance

4.1.4.3 It shall include, within the same metal enclosure number of MV functional units required for connection,

- Power supply including the battery bank for controlling the LBS and breakers ,
- Load break switches,
- Earthing Switches
- Breakers
- Relays

4.1.4.5 Equipment and material conforming to any other standard, which ensures equal or better quality, may be accepted. In such case copies of English version of the standard adopted shall be submitted.

4.1.4.6 The electrical installation shall meet the requirement of Indian Electricity Rules, 1956 as amended up to date, relevant IS code of practice and Indian Electricity Act, 1977. The Electricity Act, 2003 and Amendment if any shall also apply. In addition other rules and regulations applicable to the work shall be followed. In case any discrepancy the most stringent and restrictive one shall be binding.

4.1.4.7 The high-tension switch gear offered shall in general comply with the latest issues including amendments of the following standards but not restricted to them.

4.1.4.8 All design features of the proposed RMU, as described in the supplier's bid and in the bid's reference materials, shall be fully supported by the equipment actually delivered.

The key design features include those that relate to:

- Maintainability, expandability, and life span
- Ability to operate in severe outdoor environmental conditions.
- Immunity to electrical stress and disturbance.
- Acceptable insulation properties.

#### **4.1.5 Maintainability, Expandability, and Life Span**

##### **4.1.5.1 Maintainability**

- The Utility intends to be self-reliant for RMU maintenance. To this end, the Supplier shall provide the support, documentation, and training necessary to operate and repair the RMU. The Utility will prefer RMU designs that do not require periodic preventive maintenance and inspections. To facilitate expansion and maintenance, the RMUs should be of modular type.

**4.1.5.2 Life Span**

- Each RMU shall have a design life of at least 20 years from the date of final acceptance. The Contractor shall make available, at no cost to the Employer, the manufacturing drawings, wiring diagrams, bill of material, foundation detail drawings, unpacking and transportation instructions, operation & maintenance manual, As-built drawings, installation and commissioning manual, and other relevant documentation. The specific components of each component /sub-assembly shall be identified and referenced in Supplier-supplied documentation.

**4.2 Outdoor Features****4.2.1 General**

- The RMUs shall be designed specifically for indoor installation.
- In addition to the above, materials promoting the growth of fungus or susceptibility to corrosion and heat degradation shall not be used, and steps shall be taken to provide rodent proofness, hence the enclosure shall be made of Galvatite sheet of 1.6mm thickness, CRCA enclosures are not acceptable looking into the corrosiveness of the environment.

**4.2.2 Corrosion Protection**

The main SF6 tank, housing the on-load break switches and the vacuum circuit breakers, should be of no other material except 3 mm robotically stainless steel tank so as to have high corrosion resistance and ensure high longevity. This tank containing SF6 should be robotically welded and sealed for life, ensuring a leakage rate not more than 0.1 % per annum. Except for stainless steel, all steel surfaces that are not galvanized shall be treated to protect against corrosion. As a minimum, corrosion treatment shall include the following procedures:

- The surface shall be cleaned to bare material by mechanical or chemical means.
- Must be powder coated by means of seven tank process

All metal enclosures shall be treated in 7 tank Pre-treatment process

**4.2.3 Immunity to Electrical Stress and Disturbance**

The electrical and electronic components of the RMU shall conform to relevant standards concerning insulation, isolation, and the product shall comply with IEC 60270 Immunity to electrical stress & disturbance. The ability to meet these requirements shall be verified by type tests carried out by accredited test laboratories that are independent of the bidder and/or the manufacturer of the RMU components. Certified copies of all

available type test certificates and test results shall be included as part of the bidder's proposal.

#### **4.3.1 Minimum Insulation of Equipment**

- The RMUs shall be of SF6 gas-insulated type with Vacuum circuit breaker.

#### **4.4 Nameplate Information**

**RMU nameplate information shall be determined in agreement with the Employer. This information may include for example:**

- Name of manufacturer and country
- Type, design, and serial number
- Rated voltage and current
- Rated frequency
- Rated symmetrical breaking capacity
- Rated making capacity
- Rated short time current and its duration
- Rated lightning impulse withstand voltage
- Purchase Order number and date
- Month and year of supply

Each RMU shall also exhibit a Danger Board to indicate the presence of high voltage (11,000 V).

#### **4.5 Interconnecting Cables, Wiring, Connectors, and Terminal Blocks**

- The Contractor shall provide all interconnecting wires, cables, connectors, terminations and other wiring accessories such as terminal blocks required by the RMU.

##### **4.5.1 Metallic Cables**

- All metallic cables and wiring shall be of required cross-section solid or multiple strands of round copper conductors and have flame retardant insulation. All wiring shall be neatly laced and clamped.
- All wire and cable connectors and terminators shall be permanently labeled for identification. All connection points for external cables and wires shall be easily

accessible for connection and disconnection and shall be permanently labeled. Conductors in multi-conductor cables shall be individually color-coded.

#### **4.6 RMU Characteristics**

- As a minimum, the RMUs shall be equipped with on-load break switches and a fault passage indicator (FPI), circuit breakers, and numerical relays for the protection of transformer feeders, Communicable Numerical relay to be provided on the RMU. The Load Break Switches and earthing switches shall be housed in SF6 and the Circuit Breakers used in the RMU shall be vacuum interrupter type.
- In addition, each RMU shall be equipped with all necessary connectors, terminal blocks, and other accessories that will allow it to be connected to the FRTU, which in-turn will send required indications and measurements to the DMS via the communications system.

#### **4.7 General Requirements**

- Each RMU shall include its own power supply, including battery and battery charger.
- Within this context, the general requirements of the RMU shall include, but shall not be limited to provision of the following monitoring and control features:
  - Positions of local/remote switches as used to control local and remote access to circuit breakers and load break switches
  - Power supply indications including battery failure and voltage alarms
  - Open/closed position of load break switches, circuit breakers, and earthing switches
  - SF<sub>6</sub> gas-pressure low indication.
  - Circuit breaker relay indications
  - Indications of fault in the RMU's main feeder circuit as detected by the FPI
  - Load break switch and circuit breaker open/close control
  - FPI reset control



**4.8 Parameter Requirements**

The RMUs shall be suitable for cable networks of 630 Amps and loop cable networks of 400 Amps. The minimum design parameters to which their major components shall conform or exceed are summarized in the following tables.

**Table 0-1: System Parameters**

Parameter	Value
Nominal System Voltage	11 kV
Highest System Voltage	12 kV
Rated Voltage	12 kV
System frequency	50 Hz
Number of Phases	3 Phase/3 Wire

**Table 0-2: Circuit Breaker Parameters**

Parameter	Value
Lightning Impulse Withstand Voltage Phase-to-Phase & Phase-to- Earth:	75 kV (peak)
Power Frequency Withstand Voltage to Earth, Between Poles, & Across Opening Span	28 kV rms for 1 minute
Rated Short Time Withstand/Breaking Current:	20 kA (rms)
Rated Duration of Short Circuit:	3 seconds
Rated Normal Current:	630 Amps (rms)

**Table 0-3: Load Break Switch Parameters**

Parameter	Value
Rated Short Circuit Making Capacity	50 kA peak at rated voltage (both LBS & Earthing Switch)
Rated Load Interrupting Current	630 Amps

The RMU switchgear shall be capable of withstanding the specified currents without damage in accordance with the latest versions of IEC 60694 (Common Specifications for High-Voltage Switchgear and Control Gear Standards) and IS 3427 (AC Metal Enclosed Switchgear and Control Gear for Rated Voltages above 1 kV and up to and including 52 kV).

The equipment offered shall be as per the standards specified in the bid specification and if the offered equipment is tested with any other international standards which is superior to the standards specified they can also be considered and the bidder has to submit the documentary evidence for the same.

### **5 Design Details**

- The RMU shall be designed to operate at the rated voltage of 12 kV.
- It shall include, within the same metal enclosure, On-load break switch, circuit breakers and earthing switches for each Load Break Switch/Circuit Breaker.
- Suitable fool-proof interlocks shall be provided to the earthing switches to prevent inadvertent or accidental closing when the circuit is live and the concerned Load Break Switch/Circuit Breaker is in its closed position.
- The degree of protection required against prevailing environmental conditions, including splashing water and dust, shall be not less than IP 54 as per IS 12063.
- The active parts of the switchgear shall be maintenance free. Otherwise, the RMU shall be of low-maintenance type.
- The tank shall be made of minimum 3 mm thickness of robotically stainless steel.
- The Stainless Steel tank should be completely welded .
- The RMU shall be suitable for mounting on its connecting cable trench.
- For each RMU enclosure, a suitably sized nameplate clearly identifying the enclosure and the electrical characteristics of the enclosed devices shall be provided.

- The access to the cable compartment should be from the front / Side /Rear of the switchgear only to have minimum operating & maintenance space at site.
  - The RMU design shall be such that access to live parts shall not be possible without the use of tools.
  - The design shall incorporate features that prevent any accidental opening of the earth switch when it is in the closed position. Similarly, accidental closing of a Circuit Breaker or Load Break Switch shall be prevented when the same is in an open position.
- 
- The RMU tank must be equipped with a suitable pressure relief device. The pressure relief must ensure that the escaping gases are dissipated to the top of the switchgear only, designs with gas release from the bottom which requires additional arc tunnel in the trench which need to be extended in the lateral direction
  - The complete RMU shall be tested in an accredited INDIAN or FOREIGN laboratory and designed for an Internal Arc for IAC-AFLR from the rear top of the enclosure.

## **6 Earthing**

- There shall be continuity between metallic parts of the RMUs and cables so that there is no dangerous electric field in the surrounding air and the safety of personnel is ensured.
- The RMU frames shall be connected to the main earth bars, and the cables shall be earthed by an Earthing Switch having the specified short circuit making capacity.
- The Earthing Switch shall be operable only when the main switch is open. In this respect, a suitable mechanical fail-proof interlock shall be provided.

- The Earthing Switch shall be provided with a reliable earthing terminal for connection to an earthing conductor having a clamping screw suitable for the specified earth fault conditions. The connection point shall be marked with the earth symbol. The flexible connections between the earthing blade and the frame shall have a cross-section of at least 50 mm<sup>2</sup> copper or equivalent in GI.
- The Earthing Switch shall be fitted with its own operating mechanism. In this respect, manual closing shall be driven by a fast acting mechanism independent of the operator's action.

### **7 Incomer Load Break Switches**

- The Load Break Switches shall be maintenance free. With indoor canopy doors open, the position of power contacts and earthing contacts shall be clearly visible from the front of the RMU through screen printed Mimic facia.
- The mimic facia shall be a common plate, split type mimic facia is not acceptable since readjusting it causes mismatch of the diagram.
- The position indicator shall provide positive contact indication in accordance with IS 9920. In addition, the manufacturer shall prove the reliability of indication in accordance with IS 9921. These switches shall have three positions (or states), i.e., Open, Closed, and Earthed, and shall be constructed in such a way that natural interlocking prevents unauthorized operations.
- The switches shall be fully assembled, tested, and inspected in the factory.
- In case of Manual operation without motors, opening and closing shall be driven by a fast-acting mechanism independent of manual operator action.
- A facility shall be provided with an electrical operating mechanism allowing an operator at the RMU site to operate the Load Break Switches without any modification of the operating mechanism and without de-energizing the RMU.
- The switch and earthing switch mechanisms shall have a mechanical endurance of at least 1,000 operations.
- The motors for the ring switches shall be mounted outside the facia which prevents easy replacement of the motors without requiring to remove the mimic

which requires specialized training and dependency on the manufacturer. Designs which require motors to be mounted inside the mimic and modification is not acceptable.

### **8 Circuit Breakers**

- The Circuit Breakers shall be maintenance free and, when standing in front of the RMU with indoor canopy doors open, their positions shall be clearly visible, through the Mimic facia. The position indicator shall provide positive contact indication in accordance with IS 9920. The breakers shall have three positions (or states), i.e., Open, Closed, and Earthed, and shall be constructed in such a way that natural interlocking prevents unauthorized operations. They shall be fully assembled, tested, and inspected in the factory.
- An operating mechanism shall be used to manually close the Circuit Breaker and charge the mechanism in a single movement. It shall be fitted with a local system for manual tripping. There shall be no automatic reclosing. The Circuit Breaker shall be capable of closing fully and latching against the rated making current. Mechanical indication of the OPEN, CLOSED, and EARTHED positions of the Circuit Breaker shall be provided.
- Each Circuit Breaker shall operate in conjunction with a suitable protection relay under transformer feeder/ circuit phase and earth fault conditions.
- The motors for the Circuit breakers shall be mounted outside the facia which prevents easy replacement of the motors without requiring to remove the mimic which requires specialized training and dependency on the manufacturer. Designs which require motors to be mounted inside the mimic and modification is not acceptable.
- The VCB shall be provided with reliable manual spring charging mechanism, design which have inbuilt spring charging handle is not acceptable since the breakage of the plastic spring charging handle will render the whole breaker unusable.

### **9 Cable Termination**

- Bushings shall be conveniently located for working with the specified cables and shall allow for the termination of these cables in accordance with the prevailing

practice and guidelines of cable manufacturers. The dimensions of the terminals shall be in accordance with IS 10601.

- Designs with Aluminium cable bushings are not acceptable.
- A non Ferro-magnetic cable clamp arrangement shall be provided for each cable to be terminated in the RMU.
- A suitable arrangement for the Circuit Breakers, Earthing Switches, and Load Break Switches shall be provided so that these devices can be padlocked in the "Open" and "Closed" positions.
- A permanent "Live Cable" indication as per IEC 61958 shall be provided for each cable using a capacitor voltage divider.
- It shall be possible to test the core or sheath insulation of the cables without disconnecting the cables in the cable compartment, after accessing the cable compartment.

## **10 Safety of Equipment**

- With respect to the RMU's SF6-filled equipment, any accidental overpressure inside the sealed chamber shall be limited by the opening of a pressure-limiting device in the enclosure so that the gas will be released away from the operator and to the top of the tank without endangering the operator or anyone else in the vicinity of the RMU. Designs with bottom exhaust are not acceptable.
- All manual / motorized operations, monitoring of open/close position of switches/breakers, live line indicators, FPI indication, SF6 gas pressure indication and access to the cable compartment shall be carried out from the front of the RMU only. Motor replacement should be possible without removal of mimic.

## **11 Current and Voltage Transformers.**

- The RMU shall be provided with current and voltage transformers. These CTs & PTs shall meet the electrical and mechanical ratings as per the relevant standards.

### **15.1 Current Transformers**

- 3 Nos. ring type, single core CTs shall be provided in each incoming load break switch for metering purposes. A similar arrangement shall be provided in each

circuit breaker cable compartment to mount a 3 Nos. single-core, ring type CT for protection purposes.

- The CTs shall conform to IS 2705. The design and construction shall be sufficiently robust to withstand thermal and dynamic stresses during short circuits. Secondary terminals of CTs shall be brought out suitably to a terminal block, which will be easily accessible for testing and terminal connections.
- Further characteristics and features distinguishing CTs used for metering from CTs used for protection are listed as follows:

#### **11.1.1 CTs for Protection:**

- Material : Epoxy resin cast
- Burden : 2.5VA
- Ratio : AS PER SCHEMATIC DIAGRAM
- Accuracy Class : 10P10
- The RMU's other CTs / sensors, i.e., those used by Fault Passage Indicators (FPIs), shall be supplied by the FPI manufacturer. These CTs/sensors shall be an integral part of the FPI's design to ensure that they properly match the requirements of the FPI. .

#### **11.1.2 Protection Relay**

- The RMU shall be equipped with self-powered numerical relays(*Communicable relays shall be with auxiliary power which shall be given from battery but the tripping shall be self powered philosophy*) communicable to trip the RMU circuit breakers

#### **General**

12.1 The Circuit Breaker in the RMU shall be fitted with self-powered numerical relay, i.e., one for each outgoing circuit breaker.

- 12.2 The numerical relay shall be self-powered and should provide Inverse Definite Time (IDMT) and Instantaneous protection characteristics. On this basis, the relay as a minimum shall provide:
- Phase Overcurrent Protection (50/51)
  - Earth Fault Protection (50N/51N)
- 12.3 The relay shall be provided with an input for remote tripping, which shall be realized via an electric output pulse even without presence of phase current. A flag indicator shall be installed for signaling the occurrence of trip conditions.

#### **12.4 Features and Characteristics**

12.4.1 The numerical relay shall have the following minimal features and characteristics noting that variations may be acceptable as long as they provide similar or better functionality and/or flexibility:

- It shall be housed in a flush mounting case and powered by the RMU power supply unit.
- It shall have three phase overcurrent elements and one earth fault element.
- IDMT trip current settings shall be 50-200% in steps of 1% for phase overcurrent and 20-80% in steps of 1% for earth fault.
- Instantaneous trip current settings shall be 100-3000% in steps of 100% for phase overcurrent and 100-1200% in steps of 100% for earth fault.
- Selectable IDMT curves shall be provided to include, for example, Normal Inverse, Very Inverse, Extreme Inverse, Long Time Inverse, and Definite Time. Separate curve settings for phase overcurrent and earth fault shall be supported.
- For IDMT delay multiplication, the Time Multiplier Setting (TMS) shall be adjustable from 0.01 to 0.1 in 0.01 steps.
- The relay shall also be provided with:
  - Alphanumeric Liquid Crystal Display (LCD) for relay setting.
  - Parameter change capability that is password protected.



### 13 Construction

- The RMU shall be sufficiently sturdy to withstand handling during shipment, installation, and start-up without damage. The configuration for shipment shall adequately protect the RMU equipment from scraping, banging, or any other damage.

#### 13.1 Enclosures

- All supplied enclosures shall be sized to provide convenient access to all enclosed components. It shall not be necessary to remove any component to gain access to another component for maintenance purposes or any other reason e.g mimic removal for motorization.
- Gas filling / Top up provision shall be provided outside the ring main unit without removal of mimic , design with gas filling required after removing manometer value is not acceptable since the chances of gas leakage are more during refitting of the manometer.
- The enclosures shall also be designed to ensure that the enclosure remains rigid and retains its structural integrity under all operating and service conditions with and without the enclosure door closed.
- The thickness of all enclosure panels shall be at least 1.6 mm galvatite sheet. **The appropriate corrosion treatment and finish requirements shall apply to both inside and outside enclosure surfaces. Other required features are as follows:**
- Constructed of galvatite sheet of 1.6mm thickness according to IEC 60529 with IP rating 54 or better. Must be grit/shot blasted, thermally sprayed with Zinc alloy, phosphate, and subsequently painted with polyurethane based powder paint, the overall paint layer thickness including Zinc spraying shall be of the order of 80 to 90 microns.
- Means, such as insulated heat shields and/or air vents, to prevent high temperatures from damaging the RMUs enclosed components. If air vents are installed, these vents shall in no way reduce the effectiveness of the enclosure's protective characteristics.
- A grounding terminal including grounding bolt and lock washer for connecting a 50 mm<sup>2</sup> copper or galvanized steel grounding conductor. The grounding bolt and lock washer shall be made of stainless steel.

- Means of protection against rain water, and high levels of airborne dust, should be provided.
- The indoor canopy shall have a hinged front access door with a two-point latch locking system with a latch operating lockable handle. The door shall be fitted with a perimeter flange and gasket (rubber or neoprene) to prevent the entrance of water. In addition, a means of monitoring and indicating that the door is open shall be provided.

### **13.2 Motors**

- The RMU shall be fitted with spring charging motors of high insulation class allowing the circuit breakers and load break switches to be operated without manual intervention.
- The motors for the ring switches and circuit breakers shall be mounted outside the fascia which prevents easy replacement of the motors without requiring removing the mimic which requires specialized training and dependency on the manufacturer. Designs which require motors to be mounted inside the mimic and modification is not acceptable.
- In addition to allowing circuit breaker tripping by the RMU's protection relays,
- The motors along with the supplied control card and push buttons shall allow Utility's personnel to electrically operate the circuit breakers and load break switches at site without any modification of the operating mechanism and without de-energizing the RMU.

## **14 Test**

### **14.1 Routine Factory Tests**

- These tests shall be carried out during RMU manufacture as a quality control measure, i.e., to ensure each RMU to be delivered meets the Employer's minimum requirements including all relevant standards. Recording and reporting the routine test results shall be the responsibility of the Supplier.
- At the Utility's discretion, Utility representatives will witness such testing. This may include requesting the Supplier to perform tests on RMUs selected at random from

each batch of RMUs that the Supplier deems ready to be delivered to site. Should any such test prove unsatisfactory, the Utility reserves the right to have further tests conducted and for delivery not to take place until a mutually agreed course of action has been reached.

- Further for additional reliability of the manufactured RMU it is mandatory to have the complete assembled tank tested for partial discharge.

## **15 Operating Manuals**

- The Supplier shall submit, operating manuals for all RMU components including items such as FPI, Relay, and other equipment provided by the bidder. These manuals shall be in English. They shall include the RMU operating instructions. Context sensitivity shall be used to go directly to the appropriate place in the manual.
- The manuals shall be organized for quick access to each detailed description of the operator procedures that are required to interact with the RMU functions. This shall include the procedures to define, build, edit, and expand all data points provided with the RMU.
- The manuals shall present in a clear and concise manner all information that operators, including maintenance personnel, need to know to understand and operate RMUs satisfactorily. The manuals shall make abundant use of diagrams and/or photographs to illustrate the various procedures involved.

### **15.1 As-Built Documents and Drawings**

The supplier shall submit as built documents including applicable drawings for review and approval. All deliverable documents and drawings shall be revised by the supplier to reflect the as- built RMU components including all the FPI, LLI & Relay. Any errors in or modifications to an RMU resulting from its factory and/or site acceptance test shall be incorporated. Within this same context, all previously submitted documents that are changed because of engineering changes, contract changes, errors, or omissions shall be resubmitted for review and approval. The successful bidder has to provide his quality document to Utility.

## **16 RMU:**

Test certificates certified by NABL/central Govt. or any international recognized

testing laboratory as per IEC 62271-100/200 or relevant IS Standard with latest amendments. Following Test Certificate has to be submitted. The design of the RMU used for other type tests shall be same as the internal arc tested design.

- Dielectric Withstand Test of breaker in combination with isolator.
- Short time withstand - STC withstand test
- Mechanical endurance test
- Internal Arc test - IAC Test. Tank (IAC-AFLR) top arc exhaust.
- Temperature rise test.
- Making breaking test.

### **17 Training**

All successful tenderers for switchgear shall provide training facilities for Engineers & line staff. The training shall be for not less than 3 man days. Syllabus and other details of the training shall be finalized in consultation with the Owner. Charges for training shall be borne by the contractor & should be included in the quoted rate.