

TECHNICAL SPECIFICATION FOR 11 KV MOTORISED RING MAIN UNIT OUTDOOR TYPE

1.1 SCOPE

- 1.1.1 This specification covers Design, Engineering, Manufacture, Assembly, testing, Inspection, packing of Motorized Ring Main Units with inbuilt FPI (Fully factory integrated & demonstrable at the time of inspection) with all accessories for trouble free and efficient performance and capable of being monitored.
- 1.1.2 The RMU to be supplied against this specification are required for vital installations where continuity of service is very important. The design, materials and manufacture of the equipment shall, therefore, be of the highest order to ensure continuous and trouble free service over the years.
- 1.1.3 The insulation/dielectric media inside the stainless steel welded tank (Grade SS304 - Non ferrite, Non Magnetic) should be SF6 gas. The RMU should be Modular, extensible type on single side with provision of attaching/connecting with bus / cable connected site replaceable bushings for additional load break switches and circuit breakers in future whenever required. However, RMU left side is occupied by metering panel and right side is free for extension on vice versa is also possible depending on site condition. **RMU shall be front access or access from sides.**
- 1.1.4 Ring Main Units shall be SCADA compatible for future use.
- 1.1.5 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 relay with self-power supply shall be provided for communication purpose. The RMU shall provision for include potential-free contacts and control contacts so as to connect to SCADA/DMS via FRTUs, so as to:
- Monitor and control the open/closed status of the RMU circuit breakers and load break switches.
 - Monitor the local/remote position of RMU motorized (in case if failure of motor) manually-operated switches that can be used to enable and disable remote monitoring.
 - Monitor the health of the power supply, which will include battery failure and low voltage indications.
 - Monitor the open/closed status of RMU earthing switches.
 - Monitor the open/closed status of RMU enclosure doors in case of Hinge doors.
 - Monitor for low SF6 gas pressure indication.
 - Monitor for circuit breaker relay operations.
 - Monitor for indication of main-circuit fault detected by the RMU's FPI.

- 1.1.6 The RMU offered shall be compact, maintenance free, easy to install reliable, safe and easy to operate and complete with all parts necessary for their effective and trouble-free operation. Such parts will be deemed to be within the scope of the supply irrespective of whether they are specifically indicated in the commercial order or not.
- 1.1.7 It is not the intent to specify herein complete details of design and construction. The offered equipment shall conform to the relevant standards and be of high quality, sturdy, robust and of good design and workmanship complete in all respects and capable to perform continuous and satisfactory operations in the actual service conditions at site and shall have sufficiently long life in service as per statutory requirements. In actual practice, notwithstanding any anomalies, discrepancies, omissions, in-completeness, etc. in these specifications, the design and constructional aspects, including materials and dimensions, will be subject to good engineering practice in conformity with the required quality of the product, and to such tolerances, allowances and requirements for clearances etc. as are necessary by virtue of various stipulations in that respect in the relevant Indian Standards, IEC standards, I.E. Rules, I.E. Act and other statutory provisions.
- 1.1.8 It shall also encompass all necessary project management, data engineering, acceptance testing, training, documentation, warranty services as efficiently as possible with minimum interruptions of power to Employer / customers.
- 1.1.9 Tolerances on all the dimensions shall be in accordance with provisions made in the relevant Indian /IEC standards amended up-to date and in this specification. Otherwise the same will be governed by good engineering practice in conformity with required quality of the product.

1.2 SERVICE CONDITIONS:

Equipment to be supplied against this specification shall be suitable for satisfactory continuous operation under the following tropical conditions.

- a) Maximum ambient temperature of air: 50°C
- b) Maximum temperature of air in shade: 4°C
- c) Maximum daily average ambient temperature: 40°C
- d) Maximum yearly average ambient temperature: 30°C
- e) Relative Humidity: up to 95%
- f) Average number of thunder storm days per annum: 15
- g) Maximum annual Rainfall: 150cm
- h) Maximum Altitude above mean sea level: 1000Meter
- i) Maximum Wind Pressure: 150 Kg/cm² (As per IS 802 latest code)
- j) Maximum soil temperature at cable depth: 30°C
- k) Maximum soil thermal resistivity: 150°C cm/watt

1.3 TECHNICAL PARAMETERS:

Sr No	Description	11kV RMU
1	Application	Three phase - Three wire
2	Rated Voltage	12 kV
3	Service Voltage	11 kV
4	System Frequency	50 Hz
5	SF6 gas at a relative pressure	As per IEC 62271-200 & IEC 62271-1
6	Internal Arc test	20 kA for 1 Sec for tank
7	Lightning Impulse withstand Voltage	75 kV Peak
8	Power Frequency withstand voltage	28 kVrms
9	Rated current of Circuit-breaker	630A
10	Rated Short time current withstand	20 KA for 3 sec
11	Rated Short circuit making current	50 kA
12	Number of operations at rated short circuit current on line switches, earthing switches and CB	5 close for line & earth switches and 20 nos for 11 kV VCB.
13	Opening time of breaker (max.)	2.5 cycle
14	Closing time of breaker (max.)	3 cycle
15	Breaker Duty Cycle	0-3min-CO-3min-CO
16	Fault Clearing time	70 millisecond
17	Rated cable charging interrupting current of incomer- Load Break Switch	10A
18	Rated cable charging breaking current of breaker	25A
19	Insulating medium	SF6
20	Interrupting medium	Vacuum
21	Temperature Rise	Maximum permissible temperature rise as per table 3 of IEC 60694.

1.4 APPLICABLE STANDARDS:

The RMU Switchgear shall comply with the requirements stated in the following standards and specifications amended up to date:

Standard	Description
IEC 60529	Classification of degrees of protection provided by enclosures of electrical equipment
IEC 62271-200: 2003	A.C metal-enclosed switchgear and control gear for rated voltages above 1KV and up to and including 72KV
IEC 1330	High voltage/Low voltage prefabricated substations
IEC 62271-1:2007	Common specification for HV switchgear standards
IEC 60265	High-voltage switches-Part 1: Switches for rated voltages above 1kV and less than 52kV
IEC 60801	Monitoring and control

Standard	Description
IEC 60185	Current Transformers
IEC 60186	Voltage transformers
BS 159	Busbar
IEC 60137	Bushings
BS 7430	Earthing
IEC 60255	Specification for Static Protective Relays
BS 6231	Wires and wiring
IEC 61000	Electromagnetic compatibility
IEC 60129	Alternating current Disconnecter (isolators) and earthing switches
IEC 62271-200	Metal enclosed BS 5311 switchgear
IEC 62271-100	MV AC circuit breaker
IEC 60060-1 / BS 923	High Voltage test technique
IEC 60947-4-1	Control Gears
IEC 60623	Open Ni-Cd prismatic rechargeable cell
IEC 60376	Filling of SF6 gas in RMU

Equipment meeting with the requirements of any other authorities standards, which ensures equal or better quality than the standard mentioned above as well as latest standard shall also be acceptable. If the equipments, offered by the Bidder conform to other standards, salient points of difference between the standards adopted and the specific standards shall be clearly brought out in relevant schedule. In case of any difference between provisions of these standards and provisions of this specification, the provisions contained in this specification shall prevail. One hard copy of such standards with authentic English Translations shall be furnished along with the offer.

1.5 GENERAL TECHNICAL REQUIREMENT:

1.5.1 Configuration:

- 2-Way (CV):11KV Gas (SF6) Insulated RMU with One 630A load break switches and One 630A SF6 Insulated VCB
- 3-Way (CCV) ,11KV ,Gas (SF6) Insulated RMU with 2 Nos 630A load break switch and 1No. 630 A SF6 Insulated VCB
- 4-Way (CCVV), 11 KV Gas (SF6) Insulated RMU with 2 Nos 630A Load break switches and 2 Nos, 630 A SF6 Insulated VCB
- 5-Way (CCCVV), 11KV , Gas (SF6) Insulated RMU with 3 Nos 630A load break switch and 2 Nos. 630 A SF6 Insulated VCB
- 6-Way (CCCVV+V), 11KV Gas (SF6) Insulated RMU with 3 Nos 630A Load break switches and 3 Nos 630 A SF6 Insulated VCB

1.5.2 RMU Design Features:

The RMU are to be designed, manufactured, factory integrated with fault passage indicator, tested and delivered at site. The RMU shall be locally monitorable and/or operable for/to:

- the open/close the status of the RMU circuit breakers and load break switches.

- The health of the power supply, which will include battery failure and low voltage indications.
- the open/closed status of RMU earthing switches.
- For low SF6 gas pressure indication.
- for circuit breaker relay operations.
- for indication of main-circuit fault detected by the RMU's FPI.

1.5.3 Outdoor Enclosure Features:

The RMUs shall be designed specifically for outdoor installation with ingress protection degree of IP54. They shall also be suitable for conditions in which they will be exposed to heavy industrial pollution, and high levels of air borne dust.

The outer enclosure shall be made of CRCA, 2 mm thick with thick glands plates of 3 mm. The sheet steel and the fabricated parts shall be pretreated using 7 tank process and then coated by layer of zinc phosphate. A finish coat with high scratch resistance epoxy powder finish paint shall be applied over the primer. The coat thickness shall be minimum 100 microns +/- 25 micron.

The equipment in the proposed outdoor RMU shall be coated to meet these climatic conditions. In this respect, standards such as IEC 60870-2-2 covering equipment, systems, operating conditions, and environmental conditions shall apply along with IEC60721, which covers the classification of such conditions. All live parts, high voltage components, excluding the HV cable termination of the switchgear shall be insulated/ protected in SF6 to provide complete proofing against dangers of flashover between phase and earth and between phases. In particular, the equipment shall be climate free in that no high voltage connection will be exposed to the environment.

The complete RMU unit shall be powder coating of RAL 7032 Grey to DIN Standard 43656.

1.5.4 Indoor Enclosure Features:

The tank shall be corrosion resistant stainless steel sheet (Grade SS 304 - Non ferrite, Non Magnetic) of minimum 2.5 mm (as per relevant IS/ IEC) thickness with internal Arc Type tested and meet the 'sealed pressure system' criteria in accordance with the IEC 62271-200. This is a system for which no handling/ refilling of gas shall be required throughout the expected operating life, i.e. 30 years. Sealed pressure systems are completely assembled, filled and tested in the factory. The maximum leakage rate of SF6 gas shall be lower than 0.1% of the total initial mass of SF6 gas per annum. The filling pressure for the switchgear shall be just above the atmospheric pressure so as to reduce the tendency to leak. SF6 gas used for the filling of the RMU shall be in accordance with IEC376. It is preferable to fit an absorption material in the tank to absorb the moisture from the SF6 gas and to

regenerate the SF6 gas following arc interruption. There shall be no requirement to 'top up' the SF6 gas. The degree of protection for RMU tank, high voltage live parts, SF6 and VCB shall be IP 67. The Front cover mechanism and cable cover shall have IP2X degree of protection. After the calculation of rate of leakage of SF6 gas pressure, minimum SF6 gas inside the tank should be for 30years of life cycle.

1.5.5 The RMU shall be suitable for mounting on plinth and mounted on structure with provision for cabling through gland plate in the base and trench below. The RMU shall be designed so that the position of the different devices is visible to the operator on the front and operations are also visible. The RMU shall be identified by an appropriately sized label which clearly indicates the functional units and their electrical characteristics. The RMU shall be designed to be tamper proof so as to prevent access to all live parts during operation without the use of tools.

1.5.6 The RMU shall be completed with all connection and copper bus bar within SF6 enclosure bus bar for air exposed parts with continuous current carrying capacity of 630A as per relevant IEC/IS. The bus bar shall be fully encapsulated by SF6 gas inside the steel tank. There shall be continuity between the metallic parts of the RMU and cables so that there is no electric field pattern in the surrounding air, thereby ensuring the safety of people. The earth bus bar shall be preferably enclosed in an enclosure to prevent theft/tampering.

1.5.7 All parts of main circuit to which access is required or provided shall be capable of being earthed prior to becoming accessible. This does not apply to removable parts which become accessible after being separated from the switchgear and control gear. The cables shall be earthed by an earth switch with short circuit making capacity in compliance with IEC 62271-102. The interlocking between circuit breaker and earth switch shall be provided in such a manner to avoid accidental earthing of live bus bar. The earth switch shall be fitted with its own operating mechanism and manual closing shall be driven by a fast-acting mechanism, independent of operator action. Mechanical interlocking systems shall prevent access to the operating shaft to avoid all operator errors such as closing the earth switch when cable is charged

1.5.8 Interconnecting cables, wiring, connectors and terminal blocks:

The interconnecting wires, cables, connectors, terminations and other wiring accessories such as terminal blocks shall be in the scope of the manufacturer. Plug-type/screw type connectors shall be used for all interconnections. Suitable Disconnector type terminal blocks shall be provided for CT circuits. In using a terminal block, no more than two cables or wires shall be connected to any of its individual terminals. Self-extinguishing fireproof vinyl marking strips shall be used to identify all external connection blocks. Marking tags shall be read horizontally.

All terminals to which battery or other high voltages are connected shall be provided with fireproof covers. All individual status input, AC voltage input, and control output points shall be isolatable without the need to remove wiring by means of individual terminal blocks of the removable link type. In order to avoid open circuits on the secondary side of CTs, termination blocks with by-pass bridges shall be provided for all AC current inputs

- 1.5.9 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 Circuit Breaker/Isolator is in its "closed" position.

The unit shall be internal arc proof and tested and totally safe for human beings. The release of gas to be from the bottom of the unit, so that, even if the person is operating the unit, opening the cover, the release will be at the bottom. The release in no case should be from any side or top of the unit, as the same is unsafe for the operating personnel/pedestrian or general public. All manual operations shall be carried out on the front of the RMU.

1.5.10 Isolators/Load Break Switch:

The RMUs shall be equipped with 630Amp fault making/load breaking spring assisted ring switches, each with integral fault making earth switches. The switch shall be naturally interlocked to prevent the main and earth switch being switched "ON" at the same time. The selection of the main and earth switch is made by a lever on the front which is allowed to move only if the main or earth switch is in "OFF" position. The Ring switches shall be capable for local manual operation. The load break switch and earthing switch operating mechanism shall have mechanical endurance of at least 1000 operations.

Each INCOMING load break switch will have the following

1. Motor operated 630A Load Break switch and manually operated Earthing Switch with making capacity
2. Cable switch 11 kV, 630 A, 20 kA.
2. Mechanism for manual operation with integrated earthing switch
3. Cable bushing 630 A, standard C bushings.
4. Capacitive voltage indication fixed type- LED display.
5. Fault passage indicator with LED display and reset facility
6. Operation counters for each load break switch
7. ON, OFF, EARTH indication on the front mimic of the panel.
8. Cable box for termination of XLPE cable up to 3CX 400 sq. mm.
9. Cable entry bottom.

10. 2NO + 2 NC contacts for load break switch
11. 1NO+1NC contact for Earth switch
12. Local remote control switch for each load break switch
13. Set of Right Angled Cable Boots.

1.5.11 Vacuum Circuit Breakers

The motorized circuit breakers shall be maintenance free and the position of the power and earthing contacts shall be clearly visible on the front of the RMU through mimic. 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.

The circuit breakers shall have 2 positions (open / closed) along with earthing switch and shall be constructed in such a way that natural interlocks prevent all unauthorized operations. They shall be fully assembled, tested and inspected in the factory. Breaker operation counter should be provided. An operating mechanism shall be used to manually close the circuit breaker and charge the mechanism in a single movement in manual mode or electrically motor operated. In manual mode the operating mechanism of breaker shall be such that spring charging shall be through the handle and on/ off operation through push button. It shall be fitted with a local system for manual tripping by an integrated push button. There shall be no automatic re-closing. 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.

The circuit breaker shall be associated with an integrated protection unit that will operate without any auxiliary power supply and shall include three toroid current transformers incorporated in the cable chamber as per manufacturer standard type test design. An electronic self-powered relay, a low energy release, and a "fast-on" test receptacle for protection testing (with or without CB tripping). The protection system shall ensure circuit breaker tripping as of a minimum operating current which is the rated current of the underground network to be protected. The CT settings shall be adjustable between 600 to 300/1Amp for feeder and 100-50/1A for distribution transformer, as per the requirement at site. Protection core CT complete details should be furnished (Burden, class, ALF).

In case cables are to be tested with front door open, doors shall have interlocks such that doors can be opened only with earth switch in closed position & a cable test rod shall be provided which can be fixed on the terminations to facilitate testing. Termination boots as approved by the Purchaser's should have a proper

opening to facilitate the testing. The opening shall be covered by means of removable protection cap.

In case of front door opened, it shall not be possible to operate the breaker. All panel covers shall be provided with anti-vandal screw bolts so that opening of panel covers is only possible with special tools, which shall be provided by the Bidder. This is required to prevent pilferage. The cable cover door shall be pad lockable and shall be Tamper and Arc proof. Double door arrangement for Outdoor breakers to be provided for additional safety. There shall be provision of hinged doors or bolted type door as per manufacturer standards type tested design. The circuit breaker and earth switch shall be lockable in the open or closed positions by 1 to 3 padlocks. Circuit Breaker shall have mechanical endurance of at least 2000 operations

Each OUTGOING Circuit Breaker will have the following

1. Motor operated 630A SF6 insulated Vacuum circuit breaker and Earthling Switch with making capacity
2. Mechanism for manual operation.
3. Self-Powered protection relay providing over-current & earth fault protection.
4. Ring core current transformers for protection depending upon the transformer ratings 2.5VA, 5P10 for protection
5. Operation counters
6. 4NO+4NC Auxiliary contacts for breaker
7. 2NO+2NC Auxiliary contact for Disconnecter
8. 1No+1NC contact for Earth switch
9. Local remote control switch for each breaker
10. Capacitive voltage indication fixed type
11. ON, OFF, Earth indication on mimic and trip indication on relay.
12. Cable box for termination of XLPE cable up to 3RX1CX400 sq. mm.
13. Emergency Trip Push Button.
14. Set of Cable boots.

1.5.12 Bus bars

The three nos of continuous bus bars made up of copper within SF6 enclosure bus bar for air exposed parts of rating current 630 A shall be provided. The short time current withstand rating shall be 20 kA for 3 second.

1.5.13 Current Transformers and potential transformers

3 nos ring type, single core CTs shall be provided in each circuit breaker for protection purpose. 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. The protection CTs shall be Epoxy resin cast with burden 5 VA for feeder and 2.5 VA for transformer and Accuracy class 5P10.

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.

Appropriate capacity CTs and PTs shall be provided in the RMU for the metering purpose. The meter shall not be in the scope of supplier but the provision and space for installation of the same in future shall be available in the separate enclosure for housing the Battery/ Charger etc.

1.5.14 Protection Relays

The relay shall be provided with Phase protection of Definite time/ IDMT element for over current and earth fault with minimum PSM-0.05, Tsm-0.01 having standard characteristics of Standard Inverse, Very inverse, Extremely Inverse as per IEC 60255-3 standard. The Earth Fault Protection shall be provided of Definite time/ IDMT element having standard characteristics of Standard Inverse, Very inverse, Extremely Inverse as per IEC60255-3 standard. The "Time Multiplier" with minimum set point of 0.05 TMS shall be available. The breaker shall have the provision of LED indication of Trip on Fault High set (DT) for over current and earth fault-min current setting-0.5 In, minimum Time Delay-20 milliseconds. The relays shall be suitable numerical relay with necessary elements as per the Purchaser's approval.

On this basis, the relay as a minimum shall provide:

- a) Phase Over Current Protection: (50/51)
- b) Earth Fault Protection: (50N/51N)

Features and characteristics:

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:

- a) It shall be housed in a flush mounting case and self powered.
- b) It shall have 3- phase over-current elements and One earth fault element.
- c) IDMT trip current settings shall be 20-200% in steps of 1% for phase over-current and 10-80% in steps of 1% for earth fault.
- d) Instantaneous trip current settings shall be 100-3000% in steps of 100% for phase over-current and 100- 1200% in steps of 100% for earth fault.

e) 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 over-current and earth fault shall be supported.

f) 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)
- Parameter change capability that is password protected
- Capability to record up to 5 of the latest fault records duly time stamped and stored in non-volatile memory for subsequent reading via the above referenced RS485/RS 232 port

1.5.15 Bushings and cable terminations:

Each cable compartment shall, be provided with three bushings of adequate sizes to terminate the incoming and outgoing cables along with a terminal block (TB) located at convenient accessible location so as to wire all inputs & outputs (IOs) up to the terminal block (TB). The bushings shall be conveniently located for proper bend so as to allow easy working and termination of cables. The cable termination shall be done with Heat shrinkable /Push ON termination method so that adequate clearances are maintained between phases & cable shall be held by HDPE (fire retardant) cleat. The clearance between phase to phase and phase to earth shall be as per IEC 61243- 5 amended up to dates. 1 run of up to 3CX400 Sq. mm shall be used for cable termination. All the cable secondary wiring should be routed through marshaling box separately for relay, CT etc. Bimetallic washer for tightening of cable to be provided. RMU bushing shall be female or bus bar type for cable termination and **Bushing shall be replaceable.**

1.5.16 Earthing

The RMU outdoor metal enclosed shall be equipped with an earth bus securely fixed along the base of the RMU. Earthing shall be carried out as per attached drawing for maintenance free earthing (Appendix: A).

The earth bus bar shall be of GI strip (50sqmmX6) or copper strip (inside the RMU) having equivalent current rating and short circuit rating as per IEC/IS. Provision shall be made on end of RMU for connecting the earth bus to the earth grid by erecting suitable 2 earth pipes of 50mm dia. M.S. rod of 3 meter in Pits. Both the earth pipes are also to be connected in a grid formation.

1.5.17 Voltage indicator lamps and phase comparators

Each function shall be equipped with a fixed type voltage indicator box on the front to indicate whether or not there is voltage in the cables. The capacitive dividers will supply low voltage power to the lamps. Three inlets can be used to check the synchronization of phases. These devices shall be in compliance with IEC 61958 standard. Voltage indicator lamp shall be operating individually per phase. VDI shall be visible from outside without opening the doors.

1.5.18 Front cover

The front cover shall provide a clear mimic diagram that indicates the different functions. The position indicators shall give a true reflection of the position of the main contacts. They shall be clearly visible to the operator. The lever operating direction shall be clearly indicated in the mimic diagram. The bidder shall provide a marking plate showing RMU's main electrical characteristics.

1.5.19 Fault Passage Indicator .

Fault Passage Indicators shall be installed on the Ring Main Unit. This shall facilitate quick detection of faulty cable. The FPI shall be in integral part of one isolator and shall be capable of displaying fault. The fault indication may be on the basis of monitoring fault current through the device. These devices shall be electronic devices with their own energy source and connected to Single 3 phase Split Core CTs (CBCT). These shall be provided with bright LEDs / flag Indicators, which shall be clearly visible in the day time. These shall have the following resetting facilities:

- Manual reset
- Resetting after a set time duration
- Electrically reset from remote with at least 2-spare potential free contacts.
- Resetting on restoration of LV

The unit shall have Short Circuit and Earth fault adjustable to different settings with separate Current transformer. They shall be fully field-programmable and shall have o/c setting 100-1000 A and E/F setting 10-100 A. To restrain operation of fault passage indicators due to inrush / switching current, settings of time delay of 1s-5s shall be available. It shall be possible to Test these indicators at site thru "Test" push button.

The conventional practice is to have (N-1) FPI where N is nos. of LBS in a particular configuration of RMU. FPI shall be visible from outside without opening the doors.

1.5.20 Paint

All paint shall be applied on dean dry surfaces under suitable atmospheric conditions by seven tank process and powder coating. The overall paint thickness shall not be less than 100 microns ± 25 micron as standard. The paint shall not scale off or crinkle or be removed by abrasion during normal handling. The enclosure of the RMU shall be painted with shade Dark Gray i.e. RAL 7032. Sufficient quantity of touch-up paint shall be furnished for application at site. Paint shall be capable to withstand in saline conditions. Paint shall be capable to withstand in saline conditions.

1.5.21 Name Plate & Marking

All the components and operating devices of the RMU shall be provided with durable and legible nameplates containing all technical parameters. Name plates shall be suitably embossed with the following information. A Danger plate of appropriate size shall also be provided on the enclosure.

- Manufacturer's Name
- Month and year of supply
- PO Number and Date
- Name of DISCOM
- Rated Voltage
- System Frequency
- RMU Configuration
- Rated Short Time Withstand current for 3 sec
- Rated Impulse withstand Voltage
- Degree of Protection
- Type Designation or Serialno.
- Year of manufacture
- Applicable Rated values
- Mass of unit
- SF6 gas filling pressure

1.5.22 Power Supply and Battery with its Auxiliary

Each RMU Shall Include its own power supply unit including (auxiliary power transformer, maintenance free batteries, and battery charger) which shall provide a stable power source for the RMU. The RMU shall be supplied with battery charger for charging of 24V DC, 48 AH battery set for FRTU and for charging battery for motorized operation of RMU. Separate auxiliary transformer for charging of battery to feed the auxiliary load of RMU and FRTU and its circuit shall be provided with 500 VA burden. While the metering PT shall be provided with 10VA burden.

- Monitor the health of the power supply, which will include battery failure and low voltage indications.
- Battery and battery charger, to provide stable as per motor rating, 24 V DC, power for the RMU's Motor.
- The batteries shall have minimum life of Five (5) Years.
- The 24 V DC Batteries shall have sufficient capacity to supply power to the following devices with a normal backup of 4 hours.
 - (1) RMU's motors for a minimum of five (5) operations
 - (2) RMU's trip coil, close coil, FPI
- To Prevent deep discharge of the batteries on loss of AC power source, the battery charger shall automatically disconnect all circuitry fed by the batteries following a user-adjustable time period or when the battery voltage falls below a preset value. If the battery voltage falls below the pre set value, the time to fully recharge all batteries shall not exceed twenty-four (24) hours.
- An automatic battery checking device shall be provided to check the battery's health and initiate a battery-failed alarm signal in case battery deterioration is detected. Such detection may be based on comparing measurement value with set values (e.g, internal resistance, voltage, etc.)
- The battery charger shall be fully temperature compensated. The battery charger shall be provided with an alarm displayed at the local control panel and remotely at the DAS to account for any of the following conditions.
 - (1) Low battery voltage
 - (2) High battery voltage
 - (3) Battery failed
 - (4) Battery charger overvoltage
 - (5) Grounded battery/battery -charger
 - (6) Others according to manufacturer's design.

1.6 TESTING & INSPECTION

1.6.1 General:

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 in the specification. The type tests produced by supplier shall be only from reputed NABL accredited/ National Govt. approved testing laboratories. Report from any other testing lab mentioned above shall not be accepted. In such a case manufacture has to perform the repeat type test for the RMU from these labs at his own cost. The type test report shall have been conducted during the period not exceeding Seven (7) years from the date of opening of the bid. In the event of any discrepancy in the test

reports i.e. any test report not acceptable or any/ all type tests (including additional type tests, if any) not carried out, same shall be carried out without any cost implication.

Prior to acceptance testing, the supplier shall prepare and submit a detailed Manufacturing Quality Plan (MQP) and routine/ inspection test plan for review and approval.

After placing of order by MGVCCL to successful bidder, supplier has to get approval of drawings. The supplier shall have to offer proto inspection for RMU. The supplier shall have in house testing facility for carrying out proto inspection, lot inspection by the utility at the works of supplier. All the equipment used must be up to date and calibrated by reputed agency. The Test Specified in Acceptance test & Routine test carried out during the proto Inspection.

1.6.2 Type tests:

Following shall constitute the type tests: -

- a) Short time current withstand test and peak current withstand test.
- b) Lightning Impulse voltage with-stand test
- c) Temperature rise test.
- d) Short Circuit current making and breaking tests.
- e) Power frequency voltage withstand test (dry).
- f) Capacitive current switching test confirming to IEC.
- g) Mechanical operation test.
- h) Measurement of the resistance of the main circuit.
- i) Checking of degree of protection of main tank and outer enclosure
- j) Switch, circuit breaker, earthing switch making capacity.
- k) Switch, circuit breaker breaking capacity.
- l) Internal arc withstands.
- m) Checking of partial discharge on complete unit.

In addition, for switches, test reports on rated breaking and making capacity shall be supplied.

For earthing switches, test reports on making capacity, short-time withstand current and peak short-circuit current shall be supplied.

The Type tests produced by supplier shall be only from reputed NABL accredited /international/National Govt. approved testing laboratories

1.6.3 Routine tests:

The following routine tests shall be conducted by the manufacturer and the same shall be backed by the factory's quality control department test reports.

- a) Conformity with drawings and diagrams,
- b) Measurement of closing and opening speeds,
- c) Measurement of operating torque,

- d) Checking of filling pressure,
- e) Checking of gas-tightness,
- f) Dielectric testing and main circuit resistance measurement.
- g) Power frequency voltage
- h) Resistance test for the circuit
- i) Mechanical operation tests.

Bidders shall confirm the following routine tests on each RMU supplied.

- a) Micro ohm test (contact Resistance test) for the assembly inside the tank
- b) Circuit breaker analyzer test so as to ensure the simultaneous closing of all Poles for VCB.
- c) SF6 gas leak test
- d) Partial Discharge test on the complete gas tank so as to be assure of the proper insulation level and high service life.
- e) High voltage withstand.
- f) Secondary test to ensure the proper functioning of the live line indicators, fault passage indicators and relays.

1.6.4 Acceptance tests:

All the tests specified under Routine Test Clause above shall be carried out as acceptance test on random samples as per sampling plan under IEC/15 for each lot.

Heat Run Test shall be carried out on one random sample/configuration/tender quantity as acceptance test.

1.6.5 DOCUMENTATION and DRAWINGS

All drawings shall conform to relevant International Standards Organization (ISO) Specification. All drawings shall be in ink and suitable for microfilming.

The tenderer shall submit along with his tender dimensional general arrangement drawings of the equipment's, illustrative and descriptive literature in triplicate for various items in the RMUs which are all essentially required for future automation.

- I. Schematic diagram of the RMU panel
- II. Instruction manuals
- III. Catalogues of spares recommended with drawing to indicate each items of spares
- IV. List of spares and special tools recommended by the supplier.
- V. Copies of Type Test Certificates as per latest IS/IEC.
- VI. Drawings of equipment's, relays, control wiring circuit, etc.
- VII. Foundation drawings of RMU so that Utility will planned and carry out civil works etc.
- VIII. Dimensional drawings of each material used for item VII.

IX. Actual single line diagram of RMU/RMUs with or without Extra combinations shall be made displayed on the front portion of the RMU so as to carry out the operations easily.

The following should be supplied to each consignee circle/town along with the initial supply of the equipment's ordered.

Copies of printed and bound volumes of operation, maintenance and erection manuals in English along with the copies of approved drawings and type test reports etc.

Sets of the manuals as above shall be supplied to the Chief Engineer/Distribution.

A soft copy of the all Technical and Drawing furnished in a CD.

1.7 GUARANTEE PERIOD.

Guarantee period of RMU shall be 60 months from the date of success fully installation / commission of RMU. If RMU fails during this guarantee period, the supplier shall have to repair/replace the same at the cost of supplier at site / their works within 48 hours.

1.8 TRAINING

The supplier shall give rigorous training to the engineers & staff for 3 days for 8 persons in attending trouble shooting and maintenance at owners premise and in the field after successful installation. Training should be at free of cost.

1.9 GTP (GUARANTEED TECHNICAL PARTICULARS)

Sr. No.	Description	MGVCL Requirement	To be filled by Bidder
1.0	SWITCHGEAR ASSEMBLY		
1.1	Make		
1.2	Type	Outdoor, 2/3/4/5/6 WAY	
1.3	Reference Standard	IEC 62271-100, IEC 62271-102, IEC 62271-1, IEC 62271-103	
1.4	Voltage (Normal/Max.) kV	11kV/12 kV	
1.5	Phase (Nos.)	3 nos	
1.6	Frequency (HZ)	50 $\pm$ 3 Hz	
1.7	Short Circuit Rating for 3 Sec. (KA)	20 kA	
1.8	Insulation Level		
	a) Impulse withstand (KV peak)	75 kVp	
	b) 1 Minute 50 Hz. Voltage withstand (KV rms)	28 kV	
1.9	Metal Clad Construction	Yes	

Sr. No.	Description	MGVCL Requirement	To be filled by Bidder
1.10	a) Degree of protection for outer enclosure: b) Degree of protection for main tank :	IP 54 IP 67	
1.11	Switchgear completely wire and tested at factory (yes/No)	Yes	
2.0	CONSTRUCTION		
2.1	Overall Dimensions		
a	Extensible 2/3/4/5/6 Way RMU		
	i) Width (W) (mm)		
	ii) Depth (D) (mm)		
	iii) Height (mm)		
2.2	Overall Weight of Extensible 2/3/4/5/6 Way RMU		
3.0	Bus bar		
3.1	Make		
3.2	Material & Grade	Copper	
3.3	Reference Standard	IEC 60129	
3.4	a) Cross sectional area (mm ²)	To be filled by Bidders	
3.5	Continuous Current		
	a) Standard	630 A	
	b) At site conditions and within cubicle	630 A	
3.6	Maximum temperature rise over ambient (c)	55 Deg.C (above ambient of 50 Deg.C)	
3.7	Minimum clearance from bare bus bar connection		
	a) Phase to phase (mm)		
	b) Phase to Earth (mm)		
3.9	Bus Bar provided with		
	a) Insulation Sleeve	Yes	
	b) Phase barriers	Yes	
	c) Cast Resin shrouds for joints	Yes	
3.10	Bus bar connection	Yes	
	a) Silver Plated	Yes	

Sr. No.	Description	MGVCL Requirement	To be filled by Bidder
	b) Made with anti-oxide grease	Yes	
3.11	Bus Bar support spacing (mm)		
3.12	Bus support insulators		
	a) Make		
	b) Type		
	c) Reference Standard		
	d) Voltage Class (KV)		
	e) Minimum creep age distance (mm)		
	f) Cantilever strength Kg/mm2		
	g) Net Weight (Kg)		
3.13	SF6 gas pressure (filing pressure at 20 deg. C)	1.2 Bar	
4.0	SF6/VCB CIRCUIT BREAKER		
4.1	Make		
4.2	Type (Vacuum/ SF6)	Vacuum	
4.3	Reference Standard	IEC 62271- 1/ IEC 60694	
4.4	Rated Voltage	11 kV	
4.5	Rated Frequency	50 Hz	
4.6	No. of Poles	3	
4.7	Rated Current		
	a) Normal (Standard) Amps	630 A	
	b) Rated (Site) Amps	630 A	
4.8	Maximum temperatures rise over ambient.(deg. C)	55 Deg.C (above ambient of 50 Deg.C)	
4.9	Rated operating Duty	O- 3min- CO-3min- CO	
4.11	Breaking Capacity at rated voltage & operating duty	20	
4.12	Rated making current (KA peak)	52.5	
	b) Short time current for 3 Sec. (KA rms)	20	
4.14	Transient Recovery Voltage		
	a) Rate of rise (KV/ms)	0.34 KV/micro sec (as per IEC)	
	b) Peak Voltage (KV)	23 (35 % DC component)	

Sr. No.	Description	MGVCL Requirement	To be filled by Bidder
4.15	Insulation Level		
	a) Impulse Voltage with stand on 1/50 full wave	75 KV	
	b) 1 minute 50Hz voltage withstand	28	
4.17	Opening time Maximum, No load condition (ms)	40-60	
4.18	Opening and closing time under SF6 gas loss or vacuum loss condition (ms)	40-60	
4.19	At 100% Breaking capacity		
	a) Opening time - max (ms)	40-60	
	b) Arcing time - max (ms)	6-9	
	c) Total break time (ms)	40-60	
4.20	At 60% Breaking capacity		
	a) Opening time - max (ms)	40-60	
	b) Arcing time - max (ms)	6-9	
	c) Total break time (ms)	40-60	
4.21	At 30% Breaking capacity		
	a) Opening time - max (ms)	40-60	
	b) Arcing time - max (ms)	6-9	
	c) Total break time (ms)	40-60	
4.22	At 10% Breaking capacity		
	a) Opening time - max (ms)	40-60	
	b) Arcing time - max (ms)	6-9	
	c) Total break time (ms)	40-60	
4.23	Number of breaks per pole	Single	
4.24	No of breaker operations permissible without requiring inspection replacement of contacts and other main parts.		
	a) At 100% rated current	2000 & 40 Nos at 20kA	
4.25	Type of contacts		
	a) Main	Copper chromium, Butt type	
	b) Arcing	Copper chromium	
4.26	Material of contacts		
	a) Main	Copper chromium	
	b) Arching		
	c) Whether contacts silver plated	NA	
	d) Thickness of silver plating	NA	
4.27	Operating mechanism- closing		
	a) Type	STORED ENERGY	
	b) No of breaker operations stored	One Tripp free	

Sr. No.	Description	MGVCL Requirement	To be filled by Bidder
	C) Trip free or fixed trip	NA (Anti reflex on Earthing)	
	d) Anti pumping features provided		
	e) Earthing for operating mechanism and metal parts furnished		
	f) Earth terminal size and material		
4.28	Operating mechanism- tripping		
	a) Type		
	b) No of breaker operations stored		
	c) Trip free or fixed trip (V)		
	d) Anti pumping features provided (%)		
	e) Earthing for operating mechanism and metal parts furnished		
	f) Earth terminal size and material		
4.29	Spring charging mechanism		
	2) Make		
	3) Type		
	4) Size		
	5) Rating		
4.30	Breaker suitable for capacity switching 4 operating duty 5Max.rating of capacitor bank that canbe safely controlled	Yes	
4.31	Tripping coil		
	a) Voltage		
	b) Permissible voltage variation (%)		
	c) Tripping current at rated voltage (A)		
	d) Power at rated voltage (W)		
	e) 2-Over current trip with TLF (5A) and 1-earth fault furnished as specified		
4.32	Breaker /Accessories such as control switch indication Lamps etc. furnished as specified :(please attach separate sheet giving details of all accessories, inter locks and safety shutters)		
	a) Mechanical safety Interlock	Yes	
	b) Automatic Safety Interlock	No	

Sr. No.	Description	MGVCL Requirement	To be filled by Bidder
	C) Operational Interlock	Yes	
	d) Emergency manual trip	Yes	
	e) Operation counter	Yes	
	f) Charge /discharge indicator	Yes	
	g) Manual spring charging facility	Yes	
4.33	Impact load foundation design (to include dead load plus impact value On opening at maximum interrupting rating) (KG)		
5.0	Isolators/Load Break Switch		
5.1	Make		
5.2	Type		
5.3	Reference standard	IEC 62271-102	
5.4	Rated voltage (KV)	12	
5.5	Rated Frequency HZ	50	
5.6	No. Of poles (No)	3	
5.7	Rated current		
	i) Normal (Standard) Amps	630	
	j) Derated (site) Amp	630	
5.8	Maximum temperature rise over ambient Deg. C	55 Deg.C (above ambient of 50 Deg.C)	
5.9	Rated operation duty	O - 3min-CO-3min-CO	
5.10	Rupturing Capacity at rated voltage MVA		
5.11	Rated making current KA peak		
5.12	Short time current		
	b) For 3 sec KA rms	20	
5.13	Impulse voltage withstands on 1/50 fullwave	75KVp	
5.14	Maximum over voltage factor when switching off a) Loaded feeder cable		
5.15	Operating SF6 Gas pressure		
5.16	No of isolator operation permissible without requiring inspection, replacement of contacts and other main parts At 100% rated current At 100% rated breaking current	Yes	

Sr. No.	Description	MGVCL Requirement	To be filled by Bidder
5.17	Isolator provided with the following Mechanical safety Mechanical ON, OFF, CABLE EARTH indicators Operation counter Manual spring charging facility	Yes	
5.18	Impact load for foundation design (To include dead load plus impact Values on opening at maximum interrupting rating) Kg		
6.0	CURRENT TRANSFORMER		
6.1	Make		
6.2	Type & voltage level	Tap wound/11kV	
6.3	Reference standard	IEC 61869/IS 2705	
6.4	C.T. ratio as specified		
6.5	Rated frequency	50 Hz	
6.7	Class of insulation	Class A	
6.8	Temperature rises over ambient. Deg.C		
6.9	Basic insulation level		
6.10	For tripping CT Ratio / Class of accuracy		
	Rated Burden VA		
	Knee Point Voltage V		
	Excitation Current at $V_k/2$ Amps		
	Rated Saturating Current Amps		
	Over Current Rating		
	Continuous % Over Load %		
7.0	Cable terminations		
7.1	Circuit Breaker		
	Type		
	Materials		
	Dimensions		
	Size		
	Height of Cable box from ground Level		
	Arrangement for supplying bus end cable box furnished for extensible ring		

Sr. No.	Description	MGVCL Requirement	To be filled by Bidder
	main Unit		
	Arrangement for mounting an extra cable box on each equipment furnished		
7.2	Isolator		
	Type		
	Materials		
	Dimensions		
	Size		
	Height of Cable box from ground Level		
	Arrangement for supplying bus end cable box furnished for extensible ring main Unit		
	Arrangement for mounting an extra cable box on each equipment furnished		
8.0	Battery and its charger with Auxiliary		
8.1	Type		
8.2	Life in year		
8.3	As per Tech Spe. Clause no.1.5.22		
9.0	Name Plate		
9.1	Material		
9.2	Thickness		
9.3	Size for Breaker Cubicle Instruments / Devices		
10.0	Painting		
10.1	Finish of Breaker		
	Inside		
	Outside		
10.2	Finish of Isolator		
	Inside		
	Outside		
11.0	Drawing / Data		
11.1	General arrangement for Panel Board		

Sr. No.	Description	MGVCL Requirement	To be filled by Bidder
11.2	Foundation plan		
11.3	SF6/VCB tripping and material Schematic		
11.4	Bill of Material		
11.5	SF6/VC LT panel wiring diagram		