Technical Specification for

SCADA compatible 11 KV Non extensible 4-Way RingMain Unit

1.0 SCOPE

1.1 This specification covers Design, Engineering, Manufacture, Assembly, testing, Inspection, packing, delivery and unloading at site **of new "SCADA-Ready" Ring Main Units capable of being monitored and controlled by the Central SCADA.** 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 theyears.

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 ornot.

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, not withstanding 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.

The Tenderer/supplier shall bind himself to abide by these considerations to the entire satisfaction of the purchaser and will be required to adjust such details at no extra cost to the purchaser over and above the tendered rates andprices.

It shall also encompass all necessary project management, data engineering, acceptance testing, documentation, warranty services.

Each RMU shall include its own power supply unit (including auxiliary power transformer, batteries, and battery charger), which shall provide a stable power source for the RMU.

1.1.1 Scope of Work

- Supply of SCADA Ready 4 wayRMU.
- Supply of battery charger and battery.
- Supply of right angle boots for covering the bare cablelug.

1.2 Tolerances: Tolerances on all the dimensions shall be in accordance with provisions made in the relevant Indian/IEC standards amended upto date and in this specification. Otherwise the same will be governed by good engineering practice in conformity with required quality of theproduct.

1.3 Key RMUComponents

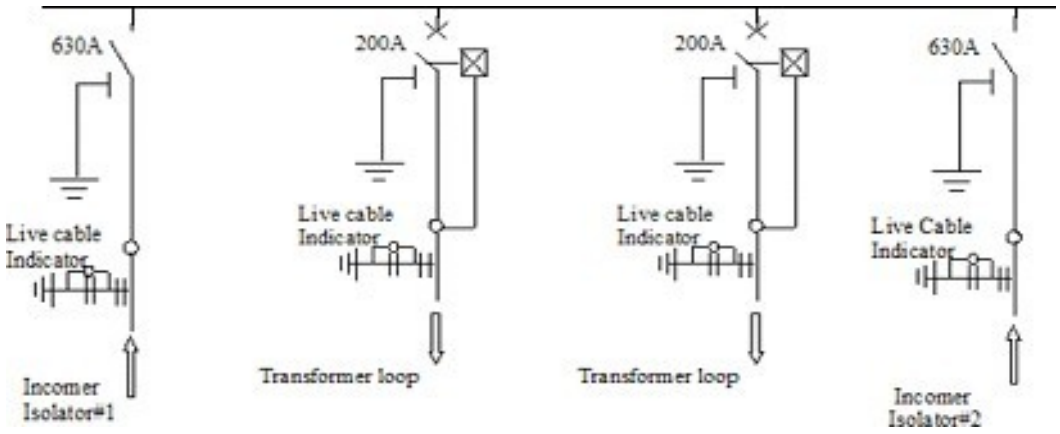
Key RMU components are listed as follows:

- Two (2) Isolators with earthing switches, connecting the RMU to incoming and outgoing main loop, 11 kV, **630 Amp XLPE cables of size 400/300 mm²** cross section aluminium conductor.
- Two (2) circuit breakers (CB) with earthing switches, connecting the RMU to distribution transformers loop, 11 kV, 200 Amp XLPE cables of size 185 mm^2 cross section aluminium conductors.
- One numerical relays having non-directional O/C and E/F protection for each outgoing feeder. In case of 630 KVA and above wet type transformer, auxiliary relay for transformer supervision shall be provided. Both the Incomers shall have FPI with electrical reset facility.
- All necessary current sensors for metering andprotection.
- All necessary potential-free contacts for indications relevant to RMU monitoring and control.
- A power supply unit, including auxiliary power transformer and battery backup, to provide stable 24 V DC sources of power for the RMU's spring-charge motors, relays etc. The power supply shall also provide for RMU enclosure lighting fixtures and power-plug receptacles for maintenance/testequipment.
- Capacitor voltage dividers serving live-line cable indicators.

A typical four-way RMU configuration is illustratedin

Figure-1. In this case**,** the RMU has five enclosures, one for each of the two Isolators and two circuit breakers and one for the RMU's auxiliary power supply unit and the necessary SCADA monitoring and control equipment. The SCADA monitoring and control equipment includes the RTU and modem to be supplied by others.

Figure-1: Typical RMU Configuration



1.4 Applicable Standards

The RMUs shall be manufactured to the highest quality consistent with best practice and workmanship and in full accord with the Contractor's **quality assurance plan**. The RMUs and the work associated with their installation shall also conform to the Indian and equivalent international standards that areapplicable.

The Contractor shall provide an English language copy of the applicable Indian and equivalent international standards met by the proposedRMU.

Rating, characteristics, tests and test procedures etc. for the RMU , protection Relays, monitoring and control devices and accessories including current transformer shall comply with the provisions and requirements of the standards of the IEC and IS where specified.

The latest revision or edition in effect at the time of bid invitation shall apply. Where references are given to numbers in the old numbering scheme from IEC it shall be taken to be the equivalent number in the new five-digit number scheme. The bidder shall specifically state the precise standard, complete with identification number, to which the various equipments and materials are manufactured and tested. The bid document may not contain a full list of standards to be used, as they only are referred to where useful for clarification of thetext.

Table 1-1: Applicable Standards

Standard	Description
IEC 60529	Classification of degrees of protection provided by enclosures of electrical equipment
IEC 60298	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 60694	Common specification for HV switchgear standards
IEC 60265	High-voltage switches-Part 1: Switches for rated voltages above 1kV and less than 52 kV
IEC 60801	Monitoring and control
IEC 60185	Current Transformers
IEC 60186	Voltage transformers
BS 159	Busbar
IEC 60137	Bushings
CP 1013(British Code of Practice)	Earthing
IEC 60255	Specification for Static Protective Relays
BS 6231	Wires and wiring
IEC 61000	Electromagnetic compatibility
IEC 60129	Alternating current Disconnector (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 60034-1	Motors
IEC 60947-4-1	Control Gears
IEC 60623	Open Ni-Cd prismatic rechargeable cell
IEC 376	Filling of SF6 gas in RMU

1.5 Environmental Conditions

All materials supplied and installed shall be capable of operating without fault in a tropical climate, which exhibits a high level of ultra-violet radiation and severe thunderstorms. Relevant environmental conditions are listed as follows:

- Maximum ambiantairtempérature: 40°C
- Minimum ambiantairtempérature: 10°C
- Maximumrelativehumidity: 95%

- Average thunder storm daysperannum: 50
- Average rainfallperannum: 1450mm
- Maximumwindpressure: 150 km/sq.m
- Altitude above meansea level: Max. 1000m

1.6 Distribution Network ElectricalParameters

The main parameters of the WBSEDCL distribution network are as follows:

- Nominalsystemvoltage: 11 kV(rms)
- Highestsystemvoltage: 12 kV(rms)
- Numberofphases: 3 ph/3wire
- Frequency: 50 Hz
- Typeofearthing: Solid
- Ratednormalcurrent: 630 Amp (RingSwitch)
  200 Amps (Transformer Feeder)
- Power frequency withstand voltage 28 kV for 1min
- Number ofelectricaloperations at full load current 100 O/C
- Rated cable charging interrupting Current forLineSwitch 25A
- Rated magnetizinginterrupting current forLineSwitch 16A
- Minimum number of operationsatrated short circuit current on circuitbreaker 10 breaking operations
- Number of operationsat rated short circuit current on lineswitches, earthing switches and CB 5 closing operations
- Basic impulse withstand voltage Ph to ph&phtoearth : 75 kVpeak
- Faultlevel(minimum) : 18.4 kA for 3 sec for12kV
- Rated short circuit making capacity : 46kA peak at ratedvoltage of line switches and earthingswitches and CB
- ClimaticCondition : Moderately hot and humid tropical climate conducive to rust andfungus growth.
- Visibleoraudiblecoronawithswitchgearenergizedat12kVphasetoearthat50Hz : None
- Circuit Breaker : In addition to the ratings mentioned in this specification, the circuit breaker shall have following:

Cable charging breaking current	25A
Small inductive breaking current	16A

General data, enclosure and dimension:-

Sl. No	Description	WBSEDCL Requirement
1.	Standard to which Switchgear complies	IEC
2.	Type of Ring Main Unit	Metal enclosed panel type, Compact module
3.	Number of phases	3
4.	Whether RMU is Type tested	Yes
5.	Whether facility is provided with pressure relief	Yes
6.	Insulating gas	1.3 bar at 20^{o} C
7.	Gas leakage rate	0.1% per year
8.	Expected operating lifetime	30 Yrs.
9.	Whether facility is provided for gas monitoring	Yes, temperature compensated manometer can be delivered.
10.	Material used in tank construction	Stainless steel
	Operations, degree of protection and colors	
1.	Means of switch operation	Separate handle
2.	Means circuit breaker operation	Separate handle and push buttons
3.	Rated operating sequence of Circuit Breaker	O-3min-CO-3min-CO
4.	Opening time of circuit breaker	Approx. 60-80 ms.
5.	Closing time of Circuit Breaker	Approx. 40-60 ms.
6.	Mechanical operations of Disconnector switch	1000
7.	Mechanical operation of earthing switch	1000
8.	Mechanical operations of circuit breaker	2000
9.	Disconnector switch/earth switch	3 position combined switch/earth switch

	Degree of Protection	
1.	High voltage live parts, $SF_{6,}$ VCB	IP67
2.	Front cover mechanism	IP2X
3.	Cable cover	IP 2X
4.	Outdoor Enclosure	IP54

1.7 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. Prior to testing, the Contractor shall prepare and submit a detailed test plan for review and approval by the Employer.

1.8 RMU DesignFeatures

All design features of the proposed RMU, as described in the Contractor'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:

- Availability, maintainability and lifespan
- Ability to operate in severe outdoor environmentalconditions
- Immunity to electrical stress anddisturbance
- Acceptable insulation properties
- Termination to SCADA Terminal Box for convenient RTU interconnectionfeatures

In these and all other specified respects, the RMU shall meet or exceed the cited standards or where appropriate, other equivalent industry standards.

1.9 Availability, Maintainability and LifeSpan

1.9.1 Availability

The RMU shall be designed to have a fully enclosed metal housing combined with the single-phase insulation of all primary live parts to reduce the risk of internal faults to an absolute minimum and to provide a high degree of safety as well as availability. Nevertheless, manufacturer standard designs shall be used to the fullest extent possible.

Each RMU shall exhibit an availability of greater than 99.5%. To ensure this high degree of availability, the RMUs shall be fabricated, assembled, and finished with workmanship of the highest production quality and shall conform to all applicable quality control standards. All materials comprising the RMU shall be new, unused, and of the best industrial grade, and the RMU shall incorporate all recent improvements in both design and materials. All components shall be of current production from reliable component manufacturers.

1.9.2 Maintainability

The Employer prefers RMU designs that do not require periodic preventive maintenance and inspections. If periodic maintenance is required, it shall be possible to perform all such work in the field without requiring the associated distribution network circuits to be de-energized.

1.10 OutdoorFeatures

1.10.1 General

The RMUs shall be designed specifically for outdoor installation and, in this respect, shall be suitable for continuous operation in a tropical climate that includes exposure to severe frequently occurring thunderstorms. They shall also be suitable for conditions in which they will be exposed to heavy industrial pollution, salt-spray, and high levels of airborne dust.

The equipment in the proposed outdoor RMU shall be conformably 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 IEC 60721, which covers the classification of such conditions. In particular, the RMU equipment shall have been type tested for continuous operation under the environmental conditions identified in Clause1.5.

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 proof installations.

All live parts, high voltage components, excluding the HV cable termination of the switchgear shallbe insulated/ protected in SF_6 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 theenvironment.

1.10.2 CorrosionProtection

The fabricated parts are pretreated using 7 tank process and then coated by layer of zinc phosphate. A finish coat with high scratch resistance or epoxy powder finish paint shall be applied over the primer. The coat thickness shall be of the order of 40 to 60 micrometers. The Employer shall approve the finish-coat color. The RAL-7032/RAL-7035/IEC 632 code will be agreed upon with the Bidder during the early design phases of project implementation.

1.10.3 Material

Except for main tank and external hardware which made of stainless steel, all structural steel and outer enclosure as well as nuts and bolts etc. shall be of CRCA steel with epoxy powder finish paint..

1.11 Immunity to Electrical Stress andDisturbance

The electrical and electronic components of the RMU shall conform to relevant standards concerning insulation, isolation, and immunity from electromagnetic interference, radiated disturbance, and electrostatic discharge. 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. Failure to conform to this requirement shall constitute grounds for rejection of the proposal.

1.12 Minimum Insulation ofEquipment

The RMUs shall have SF_6 gas-insulated type stainless steel tank with joints inside tank. All live parts shall be fully insulated throughout their joints.

1.13 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 serialnumber
- Rated voltage andcurrent
- Ratedfrequency
- Rated symmetrical breakingcapacity
- Rated makingcapacity
- Rated short time current and itsduration
- Rated lightning impulse withstandvoltage
- Purchase Order number anddate
- Month and year ofsupply
- Property label: Property ofWBSEDCL
- Guarantee period : 5years

1.14 DangerBoard:

The Danger Board plate as per relevant IS shall be riveted on the front plate of the RMU.

1.15 Interconnecting Cables, Wiring, Connectors, and TerminalBlocks

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

1.15.1 Cables

All metallic cables and wiring shall be of required cross-section 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.

The DC cables from the battery unit to RMU and to pilot marshalling box shall be atleast $4mm^2$. CT & OT Control cable will be 2.5 Sq. mm and all other control cable shall be 1.5 mm^2 Cu multi-conductorandshallbescreenedwithhalf-lappedcoppertape.Allwiringandterminationof

connecting cables shall be carried out by the Contractor. Conductor used for AC and DC circuits shall not be mixed in the same multi-conductor cable.

All wires shall be neatly run in groups and shall be securely fixed by cleats which are made of insulating material. Suitable crimped connectors shall be used for the termination of the wire to the terminal blocks.

All wires, including the spare cores of a multi-core cable, shall be properly numbered by an approved type of interlocking ferrule. All spare relay contacts shall also be wired out to spare terminal block inside the panels. The marking on the ferrules shall not be erased easily. The colour of DC supply circuits shall be grey to differentiate from AC supply for easy identification.

All wiring colour classification, wire terminal sleeve colour and wire numbering system shall be subjected to WBSEDCL's approval.

All AC and DC wiring terminals that are easily accessible by operating personnel shall be adequately shielded by suitable means.

1.15.2 Connectors

Plug-type connectors with captive fasteners shall be used for all interconnections. The connectors shall be polarized to prevent improper assembly.

1.15.3 TerminalBlocks

Suitable Disconnector type terminal blocks shall be provided for CT circuits with necessary spares with 5 mm minimum machine screws shall be provided by the Contractor for other necessary metallic cable terminations. 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 currentinputs.

Terminal blocks shall comply with IEC 60947-7-1 (2009): Low-voltage Switchgear and Control Gear, Part 7-1: Ancillary Equipment, Terminal Blocks for Copper Conductors.

TBs shall be mounted onto suitable insulation materials via channels. TBs shall be able to withstand 5kV AC rms voltage continuously for 1 minute between terminal and terminal to earth.

One TB shall be used for one feeder panel. Translucent cover shall be provided for all cable termination blocks. TBs shall be suitably spaced and labeled to enable easy and neat termination. Each terminal shall be labeled according to the panel number. **The use of embossing tape for such purpose is not acceptable.**

1.16 General Requirements

Each RMU shall include its own power supply, including battery and battery charger. In addition, space must be provided for the RMU's auxiliary power transformer.

Within this context, the general requirements of the RMU shall include, but shall not be limited to provision of the following local and remote monitoring and control features through SCADA:

- Positions of local/remote switches as used to control local and remote access to circuit breakers.
- Power supply indications including battery failure and voltagealarms.
- Open/closed position of circuit breakers, and earthingswitches.
- Enclosure door-openindications.
- SF_6 gas-pressure low alarm andLockout.
- Isolator/Circuit breaker spring chargeindications.
- Circuit breaker relay protectionindications.
- Circuit breaker open/close control.
- Protection device failures through built-in Watch dog contact i.e 'self monitoring' feature of relay. This indication can be wired to RTU for integration inSCADA.
- FPIindication

SCADA wire termination at Marshalling Box shall have to be standardized. Hence, sequenceof termination shall be subject to WBSEDCL's Drawing approval.

1.16.1 DesignDetails

- The RMU shall be designed to operate at the rated voltage of 12 kV. It shall consist oftwo (2) numbers of 630 Amp SF_6 insulated Isolators (incomers) and up to two (2) number of 200 Amp SF_6 insulated Circuit Breakers for load.

- It shall include, within the same metal enclosure, earthing switches for each Isolators and 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 Circuit Breaker/Isolator is in its closedposition.

- Enclosures filled with gas at suitable pressure to ensure adequate insulation and safe operation shall be used. The assembly shall not require further gas processing during its expected operationallife.

- The degree of protection required against prevailing environmental conditions, including splashing water and dust, shall be not less than IP 54.

- The active parts of the switchgear shall be maintenance free. Rest parts shall be of low-maintenancetype.

- The tank shall be made of an adequate thickness of stainless steel and internally arc tested.

- The RMU shall be suitable for mounting on its connecting cabletrench.

- For each RMU enclosure, a suitably sized nameplate clearly identifying the enclosure and the electrical characteristics of the enclosed devices shall beprovided.

- The positions of the different devices shall be clearly visible to an operator when standing in front of each enclosure with its door open. Device operations shall be clearlyvisible.

- The RMU design shall be such that access to live parts shall not be possible without the use of OEM-suppliedtools.

- 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 shall be prevented when the same is in an open position. This includes protection against accidental closing resulting from the release of any latch or spring in tension due to vibrations caused externally orinternally.

- Circuit breakers shall be enclosed in the main tank using SF6 gas as insulating and vacuum as arc quenching medium. The main tank shall be non-magnetic, non-ferrite stainless steel sheet of adequate thickness to ensure leak rate below 0.1% per year and preferably robotically/TIG welded with a pressure relief arrangement. The minimum thickness of main tank of RMU shall not be less than 2.00mm.

- The main tank (Inner enclosure of Circuit Breaker) and all Switchboard assembly shall be housed in a single compact metal clad suitable for both indoor/outdoor applications. The design of enclosure for Switchgear, RMU & Switchboard housing shall be in accordance with IEC 298.

- An absorption material such as activated alumina in the tank shall be provided to absorb the moisture from the SF6 gas. A temperature compensating gas pressure indicator offering a simple indication shall constantly monitor the SF6 insulatingmedium.

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

- **The clearances of all live parts to earth and between phases shall be to approval and shall be in no way less than clearances specified in the relevant standards of this technical specification.** All equipment shall be designed so as to minimize corona or any other electrical discharges under all atmospheric conditions.

- RMU needs to be pedestal mounted for easy bending of cables for termination with the unit, safe for temporary water logging and ease in installation at any urban location without wasting much time to make the cable trenchetc.

- The maximum allowable Dimension of 4 way SCADA compatible Non – Extendable RMU will be – Length – 2100mm, Breadth – 1000mm & Height – 2300mm.

1.16.2 SulphurHexa Fluoride Gas (SF6GAS):

The SF6 gas shall comply with IEC 376,376A and 376B and shall be suitable in all respects for use in RMUs under the stipulated service conditions. The SF6 shall be tested for purity, dew point air hydrolysable fluorides and water content as per IEC 376,376A and 376B and test certificate shall be furnished to the owner indicating all the tests as per IEC 376 for each lot of SF6 Gas.

1.17 ENCLOSURE:

All Contractor-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.

The enclosures shall also be designed to ensure that the enclosure remains rigid and retain its structural integrity under all operating and service conditions with and without the enclosure doorclosed.

1.17.1 OuterEnclosure:

The RMU enclosure (Outer) shall be made up of CRCA steel of minimum 1.6 mm thickness. The rating of enclosure shall be suitable for operation on three phase, three wire, 12 kV, 50 cycles, A.C. System with short-time current rating of 18.4 KA for 3 seconds for 12 kV supply with Panels. The complete RMU enclosure shall be of degree of protection **IP 54**. The enclosure shall provide full insulation, making the Switchgear insensitive to the environment like temporary flooding, high humidity etc. The active parts of the Switchgear shall be maintenance-free and the unit shall be of minimummaintenance.

The complete RMU unit shall be powder coating of RAL 7032/RAL 7035 Grey to DIN Standard 43656/IEC 632.

Each switchboard shall be identified by an appropriately sized label which clearly indicates the functional units and their electrical characteristics.

The Switchgear and Switchboards shall be designed such that the position of the different devices is visible to the operator on the front of the Switchboard and operations are visible.

In accordance with the standards in effect, the switchboards shall be designed so as to prevent access to all live parts during operation without the use of tools.

1.17.2 Inner enclosure (Main tank)

The tank shall be preferably made of time tested welded stainless steel sheet of adequate thickness to ensure leak rate less tank 0.1% per year. The tank shall be sealed and no

handling of gas is required throughout the service life. However, the SF6 gas pressure inside the tank shall be at 1.3 bar relative minimum to ensure the insulation and breaking functions and constantly monitored by a temperature compensating gas pressure indicator offering a simple go, no-go indication. The gas pressure indicator shall be provided with green pressure and red pressure zones. There shall be one Non – return valve to fill up the gas. The manufacturershallgiveguaranteeformaximumleakagerateof SF6gaswillbelowerthan 0.1 % / year. There shall be no requirement to 'top up' the SF6 gas. An absorption material such as activated alumina in the tank shall be provided to absorb the moisture from the SF6 gas to regenerate the SF6 gas following arc interruption. The degree of protection of the inner enclosure shall be IP 67.

Oil or Air filled Switchgear will not be considered. The temperature rise test shall be carried out on complete RMU unit and test reports shall be submitted with the offer.

The compact RMU Unit shall be provided with a pedestal made up of M.S. Angle to mount the unit on plain surface. The height of the bottom of cable box shall be 310 mm to provide the turning radius for the HT cable termination. Means of enabling the SCADA to monitor the open/closed status of the enclosure door shall be provided.

1.18 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 isensured.
- 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 makingcapacity.
- The Earthing Switch shall be operable only when the main switch is open. In this respect, a suitable mechanical fail-proof interlock shall beprovided.
- 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 earthsymbol.
- 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.
- All parts of the switchgear metal enclosure, metal relay and instrument cases, cable glands, earthing terminals and other metal work on switchgear shall be connected to earth by means of main and subsidiary earth busbars.
- The switchgear earth bar and earth conductors shall be of high conductivity copper and their sizes shall be selected in accordance with BS CP 1013 taking into consideration the rated short circuit currents of the switchgear.
- All metal parts of the switchgear which do not belong to main circuit and which can collect electric charges causing dangerous effect shall be connected to theearthing

conductor made of copper having cross section area of minimum 90 sq.mm. Each end of conductor shall be terminated by M12/equivalent quality and type of terminal for connection to earth system installation. Earth conductor location shall not obstruct access to cableterminations.

- The following items are to be connected to the main earth conductor by rigid or copper conductors having a minimum cross section of 75 sq. mm (a) earthing switches (b) Cable sheath or screen (c) capacitors used in voltage control devices, ifany.

- The metallic cases of the relays, instruments and other panel mounted equipment's shall be connected to the earth bus. The colour code of earthing wire shall be green. Earthing wires shall be connected on the terminals with suitable clamp connectors and soldering shall not bepermitted.

1.19 CircuitBreakers

The Circuit Breakers shall be maintenance free and, when standing in front of the RMU with enclosure doors open, their positions shall be clearly visible. 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 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 thefactory.

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.

The circuit breaker shall be fitted with a mechanical flag, which shall operate in the event of fault occurrences. The breaker indications **ON** and **OFF** positions shall be indicated by suitable flag. For **ON** position indication by Red flag and **OFF** position indication by Green flag shall be provided.

The circuit breaker shall be operated by the same unidirectional handle or switch. The rated operating sequence shall be **O-3min-CO-3 min-CO**.

Each Circuit Breaker shall operate in conjunction with a suitable protection relay under lateral circuit phase and earth fault conditions. In addition, the Circuit Breaker shall be provided with a motorized operating mechanism that can be remotely monitored and controlled from the SCADA.

1.20 **RING SWITCHES(Isolator)**:

They shall consist of 630 amp fault making/load breaking spring assisted ring switches, each with integral fault making/load breaking 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 fascia which is allowed to move only if the main or earth switch is in 'OFF' position. **The Ring switches shall be capable for remote SCADA operation.**

1.21 BUSBARS:

The Three nos. of continuous Busbars made up of copper of rating 630A shall be provided. The Short time rating current shall be 18.4 kA for 3 seconds for 12 kV. All joints and connectors shall be SF6 insulated in accordance to this specification. Any component directly connected to the power cables shall also be capable of withstanding the DC test voltage applied to the cables. Cross section of the Busbar shall not be less than that stated in GTP.

1.22 BUSHINGS

All the bushings shall be of same height, parallel, on the equal distances from the ground and protected by a cable cover. It is preferable to have bushings accessible from the rear side of the RMU.

1.23 CABLEBOXES

All cable boxes shall be air insulated suitable for dry type cable terminations. The cable boxes of the circuit breaker shall be suitable up to **12 kV 3Core 400/300 sq.mm XLPE** types vertically ascending cable preferably for front type connection. Necessary Right angle Boot should be supplied for cable terminations. Compound filled cable boxes are not acceptable. The cable box shall be arc resistant as per IEC 62271-200 amended upto date. The internal arc fault test on cable box shall be carried out for12 kV systems for 18.4 kA for 1 second. The clearance between phase to phase and phase to earth shall be as per IEC 61243–5 amended upto date. The cable box provided shall be of adequate dimension to house an air-insulated cable termination. It shall be able to accommodate crossing of phase cores, if necessary. The cable box shall be rated in accordance with the rated insulation level of the switchgear.

Phases of all primary terminals shall be positively marked on the main structure and not on the removable covers.

An approved type of cable gland suitable for the above mentioned cable shall be provided with each box. Heat shrinkage sleeve shall be provided if wiping cable gland is used.

1.24 VOLTAGE INDICATOR LAMPS AND PHASE COMPARATORS

The RMU shall be equipped with a voltage indication. There should be a facility to check the synchronization of phases with the use of external device. Three outlets can be used to check the synchronization of phases with the use of an external device. It shall be possible for each of the bay of the RMU to be equipped with a permanent voltage indication as per IEC 601958 to indicate whether or not there is voltage on the cables. The capacitive dividers will supply low voltage power to sockets at the front of the unit, an external push button type neonlamp

must be used to indicate live cables. The neon shall be of adequate dimensions to provide clear indication under all conditions.

1.25 Operating lever

An anti-reflex mechanism on the operating lever shall prevent any attempts to re-open immediately after closing of the switch or earthing switch. All manual operations shall be carried out on the front of the switchboard. The effort exerted on the lever by the operator should not be more than 250 N for the switch and circuit breaker. The overall dimensions of the RMU shall not be increased due to the use of the operating handle. The operating handle should have two workable positions 180° apart.

1.26 Safety ofEquipment

With respect to the RMU's SF_6-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 without endangering the operator or anyone else in the vicinity of the RMU.

All manual operations shall be carried out from the front of the RMU. The effort required to be exerted on the lever as used by the operator shall not exceed 250 N.

1.27 FrontPlate

The front plate shall include a clear mimic diagram indicating RMU functionality. The position indicators shall correctly depict the position of the main contacts and shall be clearly visible to the operator. The lever operating direction shall be clearlyindicated.

1.28 Current Transformers/Sensors

A panel shall be provided in each circuit breaker enclosure to mount single-core, CT for protection purposes. CT access for maintenance or any other purpose shall be from the front, back, or top of these panels.

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 for CTs used for protection are listed as follows:

CBCT/Current Sensors for FPI Protection (for Ring) :

- Material: Epoxy resincast
- Ratio and burden suitable as per FPI manufacturer'srecommendation.

CTs for Protection (for Outgoing) :

- Material: Epoxy resincast
- Burden:2.5VA

- Ratio: 100-50/1A
- Accuracy Class: 5 P5
- If current measurement & communication of Measured data through MODBUS protocol is done by the relay, no need for meteringcore.

1.29 ProtectionRelay

The RMU shall be equipped with self powered numerical relays as used to trip the RMU circuit breakers.

1.29.1 General

The Circuit Breaker enclosures in the RMU shall be outfitted with a communicable-type numerical (feeder protection) relay, i.e., one for each circuit breaker. The protection relay's auxiliary contacts shall be hardwired to the SCADA Terminal Block. The relay shall also interface with the RTU via an RS 485 port in order to send, as a minimum, real-time phase current , readings using the MODBUS protocol.

The numerical relay shall be self powered and be provided with Inverse Definite Minimum Time (IDMT) and Instantaneous protection characteristics. On this basis, the relay as a minimum shall provide:

- Phase Over current Protection: Non-directional(50/51)
- Earth Fault Protection : Non-Directional(50N/51N)
- Transformer supervision- Buchholtz alarm/trip, temperature alarm etc. for 630 KVA and above.

Tripping and closing of RMU shall be done through suitable tripping and closing Relay which will be interfaced with the tripping and closing coil of the RMU. A flag indicator shall be installed for signaling the occurrence of trip conditions.

1.29.2 Features andCharacteristics

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.

The make of the Numerical relay shall be as per Annexure-A.

The bidders will have to send the numerical relay of same make, model, Firmware & type as offered in the bid documents along with Engineers to Distribution Testing Department on the prescheduled date & time for testing of the relay in respect of relevant features as per specification and Communications via a MODBUS RS232/RS485 port to provide the RTU (and hence the SCADA) with phase current measurements and tripping indications. The bidder will have to provide the necessary software for testing of the communication part. This is a part of Techno-commercial evaluation and it is the responsibility of the bidder to show all the features of the relay, failing which they will not be considered as Techno-commercially acceptable. The date & time of such tests at Distribution Testing Department, WBSEDCL,will

be intimated to the bidder at least 10 (Ten) days prior to the date of testing. The particular relay thus tested will have to be supplied during execution of the Order if placed upon them.

- It shall be housed in a flush mounting case and if required, will be powered by the RMU power supplyunit.
- It shall have three phase over current elements and one earth faultelement.
- IDMT trip current settings shall be 20-200% in steps of 1% for phase over current and 10-80% in steps of 1% for earthfault.
- Iinstantaneous trip current settings shall be 100-3000% in steps of 100% for phase over current and 100-1200% in steps of 100% for earthfault.
- 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 besupported.
- ForIDMTdelaymultiplication,theTimeMultiplierSetting(TMS)shallbeadjustablefrom .01 to 0.1 in 0.1 steps.
- The relay shall have local independent LED indications for Healthy, Trip, I>, I>>, IN>, and IN>> conditions.
- The relay shall also be providedwith:
  - Alphanumeric Liquid Crystal Display (LCD) for measurement and relaysetting.
  - Communications via a MODBUS RS232/RS485 port to provide the RTU (and hence the SCADA) with phase current measurements. It is also desirable that this same means of communication can be used by the RTU to sendsetting.
  - Front USB port for local communications with a laptopPC.
  - Parameter change capability that is passwordprotected.
  - 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 USBport.

1.30 PowerSupply

Each RMU shall be outfitted with a power supply, including batteries and battery charger, suitable for operation of a 5-way RMU even if the RMU is only 4-way. The following operational specifications shallapply:

- The power supply unit shall conform to the followingrequirements:
  - Input: 230 V AC nominal from the RMU's auxiliary power transformer allowing for possible variations from 190 to 300 VAC
  - Output: Stable 24 VDC
  - Batteries: 24 VDC
  - **Receptacles: 2 x 230 V AC (for testequipment)**
  - Lighting Fixtures: One for each enclosure

- The auxiliary power transformer's inputs shall be equipped with surge protection devices in accordance with IEC62305.
- The 24 V DC batteries shall have sufficient capacity to supply power to the following devices with a nominal backup of 8hours:
  - To restore a depleted battery to 80% of full capacity in less than 8hours.
  - To deliver the load of RMU's trip coils, close coils, multifunction meters, and relays, spring chargemotor.
- The batteries shall be of sealed lead acid or Ni-Cad type, comply with IEC 60623 and shall have a minimum life of five (5) years at 25^{o}C. The nominal capacity in ampere-hours shall be the capacity for five hour discharge (C_5). The cell shall be of a suitable type for high rate/medium rate discharge (3C5 to 7C5). A cell of low rate of discharge is not acceptable. Each battery cell 9 For Lead Acid Cell) shall come with a transparent housing for the ease of checking of the battery water level. The battery shall have the capability to close and open the switches for at least 10 close-open cycles (this must be verified by calculation). When sizing the AH capacity of the battery, the effect of aging shall be taken into consideration. The AH rating of the battery shall be greater than calculated AH but not less than20AH.
- The battery charger shall be fully temperaturecompensated.
- 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 presetvalue.
- The battery charger shall be provided with an alarm displayed at the local control panel and remotely at the SCADA to account for any of the followingconditions:
  - Low batteryvoltage
  - High batteryvoltage
  - Batteryfailed
  - Battery charger overvoltage
  - Groundedbattery/battery-charger
  - Low electrolytealarm
  - Input MCBoff
  - Station AC supplyfail
  - Battery Chargerfail
  - Others according to manufacturer'sdesign
- The capacity of battery and charger and the basis of calculation shall be declared in the GTP.

1.30.1 BatteryCharger

The charger shall be designed to provide a well regulated DC supply to the load while float charging or quick charging the battery. The charger shall be the constant potential, current limiting fully automatic type. The charger shall automatically switch to float charge after the battery is restored to 80% of its nominal capacity under BOOST charge. The BOOST charge

shall be automatically ON after an emergency discharge and the duration of BOOST charge shall be less than 8 hours.

The float charge voltage shall not vary by more than +/- 2% of the set value irrespective of AC input voltage variation of +/- 10 % and of load variation from 0% to 100%. The r.m.s ripple voltage across the battery shall not exceed 1% of the nominal output voltage.

The charger shall be protected against low battery voltage and short circuit at the output by employing current limiting feature. It shall also be protected against reversed battery voltage. Suitable protection shall be incorporated for DC output, transformer secondary, rectifier etc.

The charger shall be designed to operate continuously at a temperature of 55° C. To ensure long service life for the charger, all semiconductor devices shall be of industrial grade.

The following instrument and control shall be provided on the charger:-

- Mains ON/OFF input circuit breaker with Mains ON neon or LED indicator, DC output MCBs with spare. All MCBs shall be of double pole design with auxiliary voltage freecontact.
- BOOST selector switch, Voltmeter and Ammeter to measure charger/battery voltage and current.
- All visual alarm indication shall be of LED type with its function clearlymentioned.

1.31 Distribution Automation SystemInterface

The RMU shall be equipped so that it can be monitored and controlled via the SCADA. In this respect, it shall interoperate with the RTU that will be housed in the RMU Control Cabinet. The RTU in turn will interoperate with the SCADA through public network of GPRS/CDMA.

The RMU shall have provisions for opening and closing its switches, breakers using output from the RTU. The RMU shall also supply analog and status signals to the RTU for monitoring the condition of the RMU's distribution network circuits as well as the components of the RMU. A list of input/output points required for 4-way is presented in Table 1-2 below. Digital Input points and control Output points shall be connected via auxiliary relay to be provided by SCADA Vendor and analog value and protection alarms shall be provided via IED/Relay through MODBUS through RS-485 ports.

Table 1-2: Data Points per RMU Configuration

4-Way RMU

FRTU: Site Name			RTU ADD:XXX		IP ADD: xx.xx.xxx.xxx
SINGLE POINT	Hardware Signal	State	Double Point	Hardware Signal	State
Site Name VCB1 BKR SPRING Status	SS	Charged			
Site Name VCB2 BKR SPRING Status	SS	Charged	Site Name RMU L/R switch Status	DS	Remote/ Local
Site Name LBS1 FPI fault	SS	S/C	Site Name VCB1 EARTH SW Status	DS	ON/OFF
Site Name LBS2 FPI fault	SS	S/C	Site Name VCB2 EARTH SW Status	DS	ON/OFF
Site Name LBS1 FPI	SS	E/F	Site Name LBS1 EARTH SW Status	DS	ON/OFF
Site Name LBS2 FPI	SS	E/F	Site Name LBS2 EARTH SW Status	DS	ON/OFF
VCB1 Tripped on fault	SS	Tripped	Site Name VCB1 Isolator Status	DS	ON/OFF
VCB2 Tripped on fault	SS	Tripped	Site Name VCB2 Isolator Status	DS	ON/OFF
VCB 1 WTI Status	SS	Tripped	Site Name VCB1 BRK STATUS	DS	ON/OFF
VCB1 OTI Status	SS	Tripped	Site Name VCB2 BRK STATUS	DS	ON/OFF
VCB1 Buchholtz Status	SS	Tripped	Site Name LBS1 STATUS	DS	ON/OFF
VCB 2 WTI Status	SS	Tripped	Site Name LBS2 STATUS	DS	ON/OFF
VCB2 OTI Status	SS	Tripped			
VCB2 Buchholtz Status	SS	Tripped			

MODBUS Signal	From Relay	Common Signal		State
Site Name VCB1 CURR L1	Analog value	RMU Battery Charger AC	SS	fail
Site Name VCB1 CURR L2				
Site Name VCB1 CURR L3				
Site Name VCB1 CURR E				
Site Name VCB2 CURR L1				
Site Name VCB2 CURR L2				
Site Name VCB2 CURR L3		Site Name RMU Batt Charger	SS	Fail
Site Name VCB2 CURR E		Site Name RMU Batt Volt	SS	Low
		Site Name SF6 PRESURE	SS	LOW (all four signals in series)
		RMU Door	SS	Open
		Common Signal		State
		RMU battery DC Voltage	4-20mA	Through DC Transducer

MODBUS Signal	From Relay
Site Name VCB1 Fault	O/C
Site Name VCB1 Fault	E/F
Site Name VCB2 Fault	O/C
Site Name VCB2 Fault	E/F

CONTROL	Hardware Signal	State
Site Name VCB1 BRK Control Command	Double Command	Open/ Close
Site Name VCB2 BRK Control Command	Double Command	Open/ Close
Site Name LBS1 Control Command	Double Command	Open/ Close
Site Name LBS2 Control Command	Double Command	Open/ Close
Site Name LBS1 FPI Command	Single Command	Reset
Site Name LBS2 FPICommand	Single Command	Reset

1.31.1 Numerical Relay Interface with RTU

The Bidder is required to furnish the numerical relay information that pertains to interfacing the relay with the RTU through an RS 485 serial communications link. The protocol details along with the MODBUS mapping data as implemented in each relay shall be provided. In this respect, the RMU Manufacturer in cooperation and coordination with the RTU Manufacturer/contractor shall share the responsibility of ensuring effective communications is attained between the relay and RTU, i.e., all parameters read by the relay shall also be immediately available to the RTU.

1.32 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. The Bidder shall assume responsibility for correction of all such damage prior to final acceptance of the equipment.

1.33 Control Cabinet

The RMU shall be outfitted with a separate enclosure, referred to herein as the Control Cabinet, to house the following equipment as aminimum:

- Auxiliary transformer for RMU AC Aux. Power Supply will berequired.
- SCADA terminalblocks
- RMU Power Supply Unit including Charger and Batteries
- Other equipment according to manufacturer's design

The Control Cabinet shall be similar in style and finish as the other RMU enclosures. This shall include having a minimum protection class of IP 54. It shall be tested in accordance with the latest IEC 60529standard.

The cabinet shall have a hinged front access door with a three-point latch locking system and 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.**

A metal screen with holes shall be provided on the top and bottom of the control cabinet to provide ventilation aimed at avoiding condensation inside. Venting however shall in no way reduce the effectiveness of the control cabinet's water-tight, dust-tight, and corrosion-resistant characteristics. To augment the cabinet's effectiveness in preventing the ingress of dust, insects, vermin, and small objects, all electronic parts within the control cabinet shall be enclosed in modules. Such parts and modules shall be separated from the power supply modules as also installed in thecabinet.

The thickness of all enclosure panels shall be at least 1.6 mm. The control cabinet shall also be provided with:

- Weatherproof fittings for controlcables.
- Provision for handle and padlock.
- Grounding terminal, with solder less clamp type connector suitable for steel stranded conductor of suitable diameter and complete with lock washer of stainless steel orbetter.
- Provision for separately grounding the RMU's electronicitems.
- Means of protection against rain water, corrosive salt formations, and high levels of airborne dust(IP-54).
- Circuit diagram of control unit for maintenance purpose affixedpermanently.
- Others according to manufacturer'sdesign.

1.34 AuxiliaryTransformer

The RMU shall be outfitted with a single-phase auxiliary power transformer with a turns ratio of 11000/sqrt (3) to 230, i.e., it shall be connected line-to-neutral to the RMU 11 kV bus and used to provide the required 230 VAC input to the RMU's power supply. The auxiliary power transformer shall have a capacity of at least 1.0 KVA. During supply, however, the bidder shall assess this requirement by taking into account the actual load corresponding to the RTU and Modem (supplied by others) as well as the load represented by the RMU motors, etc. In this respect, with a suitable margin approved by the Employer, the auxiliary transformer must be capable of supporting the power supply requirements that correspond to a 5-way RMU. HRC fuses shall be provided on both the HV and LV sides of thetransformer.

1.35 Motors

The RMU shall be factory fitted with Closing motors of insulation Class E or better in accordance to IEC 60085 and allowing the circuit breakers to be operated without manual intervention. Motor speed shall ensure closing in 40-60 ms. Independently of SCADA control, the mechanism shall ensure that the motors start up immediately once the spring becomes discharged, so that the breaker becomes ready for the nextoperation.

In addition to allowing circuit breaker tripping by the RMU's protection relays, the motorized operating mechanism shall be suitable for remote control by theSCADA.

The motors along with a Contractor supplied control panel shall allow Employer personnel to electrically operate the circuit breakers at site without any modification of the operating mechanism and without de-energizing theRMU.

The motors shall be of a reputable make in the form of a 24 VDC, single phase type. They shall be enclosed and completely dust proof and sized with a suitable margin to meet the torque requirement of the spring charge mechanism. The motors shall comply with IEC 60034-1 and continuously rated. An 'ON-OFF' switch shall be installed on the RMU for isolation of the motor from the supply and a thermal device or other approved means shall be provided for protection of the motor.

The DC motor shall be able to withstand 'BOOST' voltage of the battery charger.

1.36 Operating Mechanism:

1.36.1 ManualOperation:

Each of the Circuit Breaker shall be provided with an independent manual closing and opening mechanisms complete with operating handles. An approved visual indicating device coupled to the operating mechanism shall be provided to show whether the breaker is open or close.

The operating mechanism shall be of robust construction and shall be designed to operate with minimum mechanical shock and to prevent inadvertent operation due to vibration or other causes. The circuit breaker shall be operated from the front of the equipment.

1.36.2 Motorised Operation:

The circuit breakers/Isolators shall in addition be provided with motor actuator to enable them to be remotely operated. If the actuator mechanism is to be detached before manual operation is possible, simple means of detaching the mechanism shall be provided. Padlockable cover shall be provided over the actuator and its linkages.

1.37 Fault Passage Indicator(FPI)

This shall facilitate quick detection of faulty cable. The fault indication may be on the basis of monitoring fault current through the device. The unit shall be self contained requiring no

auxiliary supply. FPI shall be integral part of each Isolator and shall be capable of displaying fault. It shall have LCD/LED display and electrical reset facility. It shall sense short circuit and earth fault current separately. It shall have multiple ampere and time setting both for short circuit and earth fault. The FPI should be put through current sensor with site selectable setting/CBCT in all the three phases of the Ring of the RMUs. FPI should have suitable connectivity with the FRTUs for the SCADA purpose.

1.38 Integral Cable EarthingSwitch

Each circuit breaker/Isolator shall be provided with an integral cable earthing switch. A visual indication device coupled to the earthing switch mechanism shallbeprovided to show clearly whether the cable earthing switch is in the 'cable earthed' or 'cable unearthed' position. Each earthing switch shall bePadlockable.

1.39 Cable Testing and TestPlug

Provision shall be made for the high voltage testing of cables connected to the switchgear. All parts of the switchgear directly connected to a cable including any necessary test plugs shall be capable of withstanding at any time the high voltages that may be applied during the testing of the connected cable. The insulation between poles and to earth of the test plug should be at least 10,000 meg-ohm when tested with a 5000 volts insulation resistance tester.

1.40 Indicators

The front of the equipment shall provide clear, unambiguous indication of the position and state of the circuit breaker.

A single line diagram and mimic system of the RMUs, indicating the layout and connection of the Circuit Breakers and busbars shall be provided at the front of theequipment.

Positively driven mechanical indication of the operating positions of a switching device shall be provided. Separate labels shall indicate ON, OFF and EARTH ON for the Circuit breakers. Separate labels shall indicate MAIN SWITCH and EARTH SWITCH for breakers and earth switch mechanism.

1.41 Interlocks

Each switch panel shall be provided with a comprehensive interlocking system to prevent dangerous or undesirable operations.

The interlocks shall be by mechanical means only.

The following minimum interlocks to prevent:-

i. Inadvertent operation of the Circuit breaker from ON to EARTHposition.

ii. Opening of test access cover to access test terminals until the switch is in CABLE EARTHED position. Switch can't be closed until the test access cover has beenreplaced.

iii. Earthing of cable when Circuit Breaker is in ONposition.

iv. Inserting/ removal of a cable test plug in/from switch until the switch is in 'Cable Earth' position. After the cable test plug has been inserted, the earthing switch may be moved to the 'Unearthed' position for cable testing purpose but interlock must be provided to ensure that the switch cannot be closed.

v. Operation of switch from ON to OFF and Earth switch from Earth ON to OFF for a minimum period of three seconds subsequent to the achievement of the ON or EARTH ON positions respectively.

1.42 SF_6 Gas PressureGauge

Pressure gauge with s safety level bar marking shall be provided for monitoring SF6 gas pressure. A pair of voltage free contact shall be provided for remote monitoring of low pressure alarm. The supply and installation of the control cable to connect the contact to the SCADA terminal block shall be included in the Contractor's scope ofwork.

1.43 Padlocks

Padlocks or other approved locking devices shall be provided for locking each panel in the ON, OFF, Cable Earth or Unearthed positions.

1.44 Provision of SupervisoryControl

1.44.1 Control Circuits ofRMU

The interposing relays for remote opening and closing of the RMU shall be provided by SCADA vendor. Necessary wiring shall be provided by the Contractor upto the terminal blocks assigned for SCADA. Circuits from the motors as well as the power supply for the operation must be wired up to the TB in such a way that remote operation on the RMU are possible through the contact of the corresponding interposing relay in the supervisory control equipment.

1.44.2 Position indication of Circuitbreakers

Voltage free auxiliary contacts must be wired upto the terminal blocks assigned for SCADA interface for each circuit breaker for both ON/OFF indications.

A Remote/Local switch shall be provided to control motorized Circuit breakers.

The Remote/local indication shall be connected and wired up to a separate terminal block assigned for SCADA interface.

Voltage free contact must be wired for other alarms as detailed in Table-1-2.

1.45 TYPE and ROUTINETEST:

1.45.1 Typetests:

The equipment offered in the tender should have been successfully type tested at NABL laboratories in India or equivalent international laboratories in line with the relevant standard and technical specification, within the last 5 (five) years from the date of offer. The biddershallberequiredtosubmitcompletesetofthetypetestreportsalongwiththeoffer.

The list of type tests is as follows:

I. Short time current withstand test and peak current withstandtest.

II. Lightning Impulse voltage with-standtest.

III. Temperature risetest.

IV. Short Circuit current making and breakingtests.

V. Power frequency voltage withstand test(dry).

VI. Capacitive current switching test conforming toIEC.

VII. Mechanical operationtest.

VIII. Measurement of the resistance of the maincircuit.

IX. Degree of protection of main tank and outerenclosure.

X. Circuit breaker, earthing switch makingcapacity.

XI. Switch, circuit breaker breakingcapacity.

XII. Internal arcwithstand.

The details of type test certificate according to the composition of the Switchboard shall be submitted with the offer. 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 besupplied.

1.45.2 ACCEPTANCE & ROUTINETESTS:

All acceptance as stipulated in the respective applicable standards amended up-to-date for all the equipment shall be carried out by the supplier in the presence of purchaser's representative without any extra cost to the purchaser before despatch.

The tenderer shall have full facilities to carry out all the acceptance and routine test as per the applicablestandards.

After finalization of the program of acceptance testing, the supplier shall give 15 days advance intimation to the purchaser, to enable him to depute his representatives for witnessing thetests.

The routine tests carried out by the manufacturer at his works as per IEC 62271-200 on the RMU.

The routine tests are as follows:

1. Conformity with drawings anddiagrams,
2. Measurement of closing and opening speeds,
3. Measurement of operatingtorque,
4. Checking of filling pressure,
5. Checking of gas-tightness,
6. Dielectric testing and main circuit resistancemeasurement.
7. Power frequency voltage
8. Resistance test for thecircuit
9. Mechanical operationtests.
10. Checking of Partial Discharge on completeunit.

All major type tests shall have been certified at an independent authority with the tests carried outside country of manufacture shall be translated in English and submitted in hard copy.

The supplier in the presence of WBSEDCL's representative shall carry out all above acceptance. The supplier shall give at least 15 days advance intimation to the WBSEDCL to enable them to depute their representative for witnessing the tests.

The WBSEDCL reserves the right for carrying out any other tests of a reasonable nature at the works of the supplier/laboratory or at any other recognized laboratory/research institute in addition to the above mentioned type, acceptance and routine tests at the cost of the WBSEDCL to satisfy that the material complies with the intent of thisspecification.

1.46 INSPECTION:

The inspection may be carried out by the purchaser at any stage of manufacture. The successful tenderer shall grant free access to the purchaser's representative/s at a reasonable notice when the work is in progress. Inspection and acceptance of any equipment under this specification by the purchaser shall not relieve the supplier of his obligation of furnishing equipment in accordance with the specification and shall not prevent subsequent rejection if the equipment is found to bedefective.

The supplier shall keep the purchaser informed, in advance, about the manufacturing program so that arrangement can be made for stage inspection.

The purchaser reserves the right to insist for witnessing the acceptance/routine testing of the bought out items. The supplier shall keep the purchaser informed, in advance, about such testing program.

1.47 MANUFACTURING FACILITIES:

As RMU are having sealed pressure system in compliance with IEC 298, manufacturer shall have complete facility with state of the art equipments for ensuring the quality of product delivered strictly adhering to IEC 298 GUIDELINES. Following are the work station requirement at manufacturer place to ensure the adherence: -

1. Robotic/TIG welding station for stainless steel main tank ensuring the leak rate less than 0.1% perannum
2. Work stations with adjustable work benches and torque wrenches, giving flexibility to workmen for proper tightness of internal components of sealedtank.
3. State of the Gas leak testing system ensuring the quality of sealing and have precision to measure leak rate less than o.1% perannum.
4. High voltage testing station to have high voltage power frequency test and partial discharge measurement.
5. Computerized system to measure time travel characteristic of breaker before sealing thetank.
6. Computerized SF6 filling and testingfacility.
7. Partial Discharge Lab for conducting the partial dischargetest.

It is mandatory to have the complete assembled tank tested for partial discharge to ensure a high life and reliability of the product.

1.48 QUALITY ASSURANCEPLAN:

The raw materials/components are to be procured only from reputed manufacturers. After placement of Purchase Order, the bidder is required to produce on demand the source of each material/component along with their test certificate.

1.49 DRAWINGS:

All drawings shall conform to relevant IEC Standards Specification. All drawings shall be in ink. The Tenderer shall submit along with his tender dimensional general arrangement drawings of the equipments, illustrative and descriptive literature in triplicate for various items in the RMUs, which are all essentially required for future automation.

1. Schematic diagram of the RMUpanel
2. Instruction manuals
3. Catalogues of spares recommended with drawing to indicate each items ofspares
4. List of spares and special tools recommended by thesupplier.
5. Drawings of equipments, relays, control wiring circuit,etc.
6. Foundation drawings ofRMU.
7. Dimensional drawings of each material used for itemVii.

8. 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.

5 sets of the manuals as above shall be supplied to the Chief Engineer/Distribution. Six nos. soft copy of the all Technical documents and Drawings furnished in a CD. All drawings shall be prepared in Auto Cad and documents, literature etc. in MS OFFICE format for submission.

1.50 PACKING &FORWARDING:

The equipment shall be packed in crates suitable for vertical/horizontal transport as the case may be and the packing shall be suitable to withstand handling during the transport and outdoor storage during transit. The supplier shall be responsible for any damage to the equipment during transit, due to improper and inadequate packing. The easily damageable materials shall be carefully packed and marked with the appropriate caution symbols. Wherever necessary, proper arrangement for lifting, such as lifting hooks etc. shall be provided. Any material found short inside the packing cases shall be supplied by the supplier without any extra cost.

Each consignment shall be accompanied by a detailed packing list containing the following information:

a. Name of the consignee.
b. Details ofconsignment.
c. Destination.
d. Total weight ofconsignment.
e. Sign showing upper/lower side of thecrate.
f. Handling and unpackinginstructions.
g. Bill of material indicating contents of eachpackage.

All the equipment covered in this specification shall be delivered to the various stores of the WBSEDCL as will be intimated to the successful tenderers. The equipment shall be delivered to these stores only by road transport and shall be suitably packed to avoid damages during transit in the case of indigenous supplies.

1.51 PERFORMANCEGUARANTEE:

In the event of any defect in the equipment arising out of faulty design, materials, workmanship within a period of 5 (five) years from the date of last dispatch of any integral part of the equipment, the supplier shall guarantee to replace or repair the same to the satisfaction of the purchaser.

1.52 DOCUMENTATION:

After issue of letter of acceptance, the successful Tenderers shall submit 3 identical sets of complete drawings along with detailed bill of materials for approval, to the Chief Engineer, Planning & Engineering, Distribution. If any modifications are required on these, the same will be conveyed to the supplier who shall modify the drawings accordingly and furnish final drawings for approval. In no case delivery extension will be granted for any delay in drawing approved.

The manufacturing of the equipment shall be strictly in accordance with the approved drawings and no deviation will be permitted without the written approval of the Distribution department. All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawings shall be at the supplier's risk.

After approval of the drawings and bills of materials, the suppliers shall submit detailed packing lists for approval. After approval, copies of these packing lists shall be forwarded to the respective consignees. Copies of packing lists shall also be submitted to the respective site stores.

Before dispatch of equipment to various consignees, the suppliers shall furnish sets of final drawings, including bills of materials and wiring schedules and also sets of technical literature and commissioning manuals. These shall be in Five sets and shall be furnished to the Distribution Procurement department, positively before the dispatch of equipment. All drawings shall preferably be of A3 size. No drawing of width more than 35 cm will be acceptable. One set each of the final drawings, bill of materials, wiring schedules and commissioning manuals shall invariably be forwarded to the consignee along with the each switchgear consignment and shall be listed out in the packing list, when submitted for approval.

In case the supplier fails to furnish contractual drawings and manuals even at the time of supply of equipment, the date of furnishing of drawings/manuals will be considered as the date of supply of equipment for the purpose of computing penalties for late delivery.

1.53 SCHEDULES:

The tenderer shall fill-in the following schedules which is part and parcel of the tender specification and offer. If the schedules are not submitted duly filled-in with the offer, the offer shall be liable for rejection.

Schedule 'A' ... Guaranteed technical particulars.

Schedule 'B' ... Schedule of Tenderer'sexperience.

Any additional information may be furnished separately by the tenderer, if felt necessary by him.

1.54 ACCESSORIES &SPARES:

The following spares and accessories shall be supplied along with the main equipments at free of costs. This shall not be included in the priceschedule.

1. Charging lever for operating load break isolators & circuit breaker of each RMU.

Provision shall be made for padlocking the load break switches/ Circuit breaker, and the earthing switches in either open or closed position with lock & master key.

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Schedule-A

GUARANTEED TECHNICAL PARTICULARS FOR OUTDOOR RMU
PART 1

01.	Manufacturer's Name and Country of origin	
02.	Manufacturer's Design/Type/Model	
03.	Material used for making the body of the RMU	
04.	Standards of manufacturing	
05.	Whether painting for RMU is done as per standards	
06.	Whether the enclosure is anti-corrosive	
07.	Whether RMU metal clad has sufficient space for integration of: ▪ 2 numbers of Vacuum Circuitbreaker ▪ Sufficient space for inspection, testing,etc. ▪ Earthingarrangements ▪ Terminal output points forautomation ▪ Sufficient arrangement for future extension with Circuit Breakers	
08.	Maximum withstanding ambient temperature s	
09.	Spacing between live parts to earth	
10.	Whether RMU are designed to withstand all weather conditions including chemical industry and polluted areas	
11.	Period of guarantee of the RMU	
12.	Over all dimensions of the RMU (L x W x H). Maximum allowable – L – 2100mm, W – 1000mm & H – 2300mm	
13.	Material & Gauge of material used for fabrication of the RMU	
14.	Whether RMU is manufactured as per IEC/IS standards to hold SF6 gas without leakage	
15.	Whether RMU has provision for sensors fortemperature compensated pressure measurement in the relevant gas compartment to monitor the pressure of SF6gas	
16.	Whether RMU is sealed pressure system	
17.	Weight of RMU complete with operating mechanism	
18.	RMU is provided with necessary take off terminals for automation	
19.	Whether gas chamber is made of stainless steel	

SCHEDULE OF GUARANTEED PARTICULARS FOR BREAKER
PART 2

01.	Manufacturer's Name and Country of origin	
02.	Manufacturer's Design / Type ref/Model.	
03.	Material used for making the body of the breaker	
04.	Standards of manufacturing	
05.	Whether the breakers are manufactured as per IEC/IS standards Please give Standards no.	
06.	Maximum temperature withstand of the breakers	
07.	1) Spacing between live part to Earth inside thebreaker 2) Spacing betweenpoles	
08.	Period of guarantee of the breaker	
09.	Rated frequency	
10.	Rated voltage	
11.	Highest system voltage	
12.	Rated current	
13.	Short time current rating with duration	
14.	Certificate or report of short circuit type test	
15.	Rated operating duty cycle	
16.	Short circuit breaking current (a)Symmetrical (b)Symmetrical at ratedvoltage (c)Asymmetrical at rated voltage (i)Per Phase (ii)Average (d)DC Component	
17.	Arcing time (At rated breaking current) in ms.	
18.	Opening time	
19.	Total break time in mili sec. (a)At 10% rated interrupting capacity (b)At rated interrupting capacity	
20.	Breaking Current (a)Rated out of phase current (b)Rated cable charging current (c)Rated fault levelMVA (d)Rated capacitor breaking current	
21.	Make time in ms.	
22.	Maximum temperature rise over ambient	

	(a)Main contacts Terminals	
23.	Rated restriping voltage at 100% and 50% rated capacity. (a)Amplitude factor (b)Phase factor (c)Natural frequency (d)R.R.R.V.(Volts/micro sec.)	
24.	Dry 1 minute power frequency withstand test voltage (a)Between line terminal and earth KV RMS (b)Between terminals with breaker contacts open KV RMS.	
25.	1.2/50 full wave impulse withstand test voltage (a)Between line terminal and earth KVp. (b)Between terminals with breaker contacts open KVp.	
26.	VCB interrupter make	
27.	Contact separation distance	
28.	Type of main contacts	
29.	Contact pressure	
30.	Contact resistance	
31.	Life of the interrupter (in number of operations) (i)Tripping at rated current (ii)Tripping at maximum fault current. (Allowable maximum erosion 3 mm) (iii)Mechanical operations.	
32.	Details of main contacts making contact with the breaker truck with the panel	
33.	Control circuit voltage AC/DC.	
34.	Whether trip free or not	
35.	Whether all the interlocks provided	

SCHEDULE OF GUARANTEED PARTICULARS FOR EARTHING SWITCHERS
PART 3

Sl. No.	Description	Load Break Switch	Isolator (Earthing Switch)
01.	Manufacturer's Name and Country of origin		
02.	Manufacturer's Design / Type ref/Model.		
03.	Material used for making the body of the isolators.		
04.	Standards of manufacturing		
05.	Whether the isolators & earth positions are manufactured as per IEC/IS standards		
06.	Maximum temperature withstand of the isolators & earth switches		
07.	1) Spacing between live part toEarth 2) Spacing between fixed and moving contacts in the openposition.		
08.	Period of guarantee of the Earthing switches		
09.	Rated frequency		
10.	Rated voltage		
11.	Highest system voltage		
12.	Rated current		
13.	Short time current rating with duration		
14.	Certificate or report of short circuit type test		
15.	Rated operating duty cycle		
16.	Short circuit breaking current		
17.	Arcing time (At rated breaking current) in ms.		
18.	Opening time		
19	Whether all the interlocks provided		

SCHEDULE OF GUARANTEED PARTICULARS FOR CURRENT TRANSFORMERS
PART 4

01.	Manufacturer's Name and country of origin	
02.	Manufacturer's design ref / model	
03.	Applicable Standards	
04.	1) Type of CT 2) Ratio	
05.	Rated Primary current	
06.	Rated secondary current	
07.	Rated frequency	
08.	Transformation ratio	
09.	Number of cores	
10.	Rated output (a) For Core-I	
11.	Class of insulation	
12.	Class of accuracy For Protection	
13.	Short time current rating and its duration	
14.	Secondary resistance at 70 Deg°C	
15.	Continuous over load (percentage)	
16.	One minute power frequency dry withstand voltage	
17.	1.2/50 micro sec. impulse withstand test voltage	
18.	One minute power frequency withstand test voltage on secondary	
19.	Instrument safety factor	
20.	Type of primary winding	
21.	Literature/leaflets pamphlets about the current transformer offered	
22.	Period of guarantee	

SHEDULE OF GUARANTEED TECHNICAL PARTICULARS FOR SELF POWERED MICRO-PROCESSOR BASED NUMERICAL RELAYS
PART 5

01.	Manufacturer's Name and Country of origin		
02.	Manufacturer's design / Ref.Type		
03.	Applicable Standards		
04.	Current Setting range for (a) Over current relay (b) Earth faultElement	IDMT Definite Time	
05.	Whether the relay has the in-built facilities of IDMT, OL, EL		
06.	Details of IDMT Characteristics		
07.	Accuracy for different settings and limits of errors		
08.	Whether Alpha numeric / LED display		
09.	Whether compatible for 1 A CT Secondary		
10.	Whether draw out type		
11.	Type of case		
12.	Reset time		
13.	Burden of relay		
14.	Maximum and Minimum, operating ambient air temp.		
15.	Whether technical literature pamphlets about the relay offered.		
16.	Period of guarantee.		
17.	Certificate of Proof for Electro Magnetic Interference.		
18	Communications port – RS 232 / RS 485		
19	Communication Protocol – MODBUS		

SCHEDULE 'B'

SCHEDULE OF TENDERER'sEXPERIENCE

The tenderer shall furnish here the list of the similar orders executed/under execution by him to whom a reference may be made by the purchaser in case he considers such reference necessary.

Sr. No.	Name of the client & description of the order	Value of order	Period of supply & commissioning	Name and address to whom ref can be made

NAME OF THE FIRM----------

NAME & SIGNATURE OF THE TENDERER----------

DESIGNATION----------

DATE----------

Annexure-A

Standard Make of Relay and fitment

1.	Relays	ABB/Siemens/Schneider Electric/ C&S /CGL or OEM make
2.	Breaker Control Switch	Kaycee/Alstom/Recom
3.	Ammeter/Voltmeter Selector switch	Kaycee/ Recom
4.	Static Ammeter/ Voltmeter	AE/IMP/MECO
5.	Push Buttons	Alstom/Kaycee/Vaishno
6.	Indicating Lamps with lenses	Alstom/Kaycee/Vaishno
7.	Panel Wiring	ECKO/PHOENIX
8.	Vacuum Interrupter	CGL / BEL / SCHNEIDER / SIEMENS / ABB or OEM make
9.	FPI	Preferably OEM make