

33 kV,630 A Motorized 3 way Ring Main Unit (RMU) without FRTU and SCADA-Ready

1.0 SCOPE

The specification covers Design, manufacturing, pre dispatch testing, supply transportation, unloading at site/District Stores of APEPDCL (5 nos. District Stores and **Site/Store locations will be issued during dispatch instructions at the time of supply**) for 33 kV,630 A Motorized 3 way RING MAIN UNIT (RMU) without FRTU and SCADA-Ready” **shall provide potential free contacts wired up to Terminal Block for future SCADA integration** in accordance with the technical requirements mentioned in the specification and relevant standards. Providing of FRTU enclosure along with RMU as one unit only is in the scope of bidder. Supply of FRTU is not in the scope of the bidder. Cable supporting bushings (Fiber or Epoxy) shall be provided to avoid cable load from RMU bushings.

2.0 GENERAL:

These specifications apply to factory-built, RMU type, metal-enclosed indoor switchgears. The equipment to be supplied shall come in the form of a compact switchboard and shall meet the following requirements:

- Easy to install
- Safe and easy to operate
- Compact
- Low maintenance
- SCADA Ready
- **Battery Charger of conventional linear type (SMPS type may also accept). But it should meet the respectively load for RMU 3 way/5 way.**

The supplier shall be capable of proving that he has a broad experience in the area of 33 kV switchgears and shall provide proof that he has already supplied equipment of the equivalent type and brand which has been in operation for at least three years.

- (a) All equipment and material shall be designed manufactured and tested in accordance with the latest applicable IEC standard.
- (b) Equipment and material conforming to any other standard, which ensures equal or better quality, may be accepted. In such case copies of English version of the standard adopted shall be submitted.
- (c) The electrical installation shall meet the requirement of Indian Electricity Rules, 1956 as amended up to date, relevant IS code of practice and Indian Electricity Act, 1910. The Electricity Act, 2003 shall also apply. In addition other rules and regulations applicable to the work shall be followed. In case any discrepancy the most stringent and restrictive one shall be binding.
- (d) The high-tension switchgear offered shall in general comply with the latest issues including amendments of the following standards but not restricted to them.

3.0 Introduction

This document contains the Technical Specifications that apply to Ring Main Units with metering unit which covers the supply of fully automated Ring Main Units (RMUs) with tariff metering facility on the breaker.

4.0 Applicable Standards

The RMUs shall be manufactured to the highest quality consistent with best practice and workmanship and in full accord with the Supplier’s quality assurance plan. The RMUs shall conform to the Indian or IEC international standards that are applicable. These include the standards listed in mentioned below.

Standard	Description
IS 3427	AC metal enclosed switchgear and control gear for rated voltages above 1 kV and up to and including 52 kV
IS 12063	Classification of degrees of protection provided by enclosures of electrical equipment
IS 9920 (Parts 1 to 4)	High Voltage Switches
IS 9921 (Parts 1 to 5)	Specification for AC disconnectors and earthing switches for voltages above 1000 V
IS 13118	HV AC Circuit Breakers
IS 10601	Dimensions of terminals of HV Switchgear and Control gear
IS 12729	General requirements of switchgear and control gear for voltages exceeding 1000 V
IEC 1330	High voltage/Low voltage prefabricated substations
IEC 60694	Common clauses for MV switchgear standards
IEC 6081	Monitoring and control
IS 2705	Current Transformers
IS 3156	Voltage transformers
IS 8686	Specification for Static Protective Relays
IEC 61171-200	Standards for high voltage metal clad switchgear up to 52 KV.

The 33 kV RMUs Manufactured to any other international standards like BSS,IEC or equivalent standards not less stringent than Indian standards are also acceptable, In such cases the bidders shall enclose a copy of the equivalent international standard in English language along with Bid.

5.0 Testing criteria

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. The type test produced by supplier shall be only from reputed testing laboratories such as CPRI & ERDA from India and KEMA, Volta, KERI, CESI etc from remaining part of the globe. **Type test to be conducted in NABL or International Accredited 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.

The manufacture must have in house NABL accredited testing lab for carrying out internal inspection and testing inside the factory witness by the utility. All the Testing equipment used shall have valid calibration certificate by reputed agency.

6.0 System Parameters

Parameter Requirements

The RMUs shall be suitable for cable networks of 630 Amps and loop cable networks. The minimum design parameters to which their major components shall conform to the below mentioned table parameters.

Network	Three phases
Rated Voltage	36 kV
Service Voltage	33 kV
System Frequency	50 Hz

Lightning Impulse withstand Voltage Phase to phase, phase to earth Across the isolating distance	170 kV 195 kV
Power Frequency withstand voltage	70 kV rms
Rated Normal Current Line switches	630 Amps
Rated Short time current withstand (1 sec)	25 kA 1sec 33kV Outdoor RMU should be AFLR for 25kA as the STC rating.
Internal Arc 1 sec	25 KA 1 sec Internal ARC with Duct shall not be accepted due to safety at site.
Rated Short circuit making capacity of line switches & breaker	62.5KA
Number of operations at rated short circuit current on breaker	As per the IEC-62271 The number of operations at rated short circuit current on breaker is 100-200 only.
Rated load interrupting current Line switch	630 Amps
No load line / cable breaking current capacity	40 A OR Shall be provided as per the manufacturer's type tested design and accordingly the respective type test to be submitted. As per the specification with IEC-62271/100-200 only.
No load transformer breaking capacity	40 A OR Shall be provided as per the manufacturer's type tested design and accordingly the respective type test to be submitted. As per the specification with IEC-62271/100-200 only.

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

All of the switchgear shall be capable of withstanding this current without any damage being caused, in accordance with the recommendations IEC 62271-1 and IEC 62271-200.

7.0 Configuration requirements

The RMU shall have following configuration

3 way fully motorized outdoor type IP54, compact non extensible ring main units consist of 2 nos. Load break switches and 1 no. Circuit breaker and bus connected PT metering module inbuilt FRTU with separate compartment having facility of self healing rated for 33 KV, 630 amps, 25 KA – 1 sec STC & 25 KA – 1sec internal, **IAC –AFL arc for cable box and main tank. Should provide integrated BUS PT which suits at site requirement.**

8.0 SCOPE

The specification covers Design, manufacturing, pre dispatch testing, supply transportation, unloading at site/District Stores of APEPDCL for 33 kV, 630 A Motorized 3 way RING MAIN UNIT (RMU) with FRTU and SCADA-Ready ” in accordance with the technical requirements mentioned in the specification and relevant standards. Providing of FRTU enclosure along with RMU as one unit only is in the scope of bidder. Supply of FRTU is not in

the scope of the bidder. Cable supporting bushings (Fiber or Epoxy) shall be provided to avoid cable load from RMU bushings

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

Each RMU shall be equipped with main-line load break switches and a fault passage indicator (FPI). Furthermore, to protect each of its lateral / transformer feeders, it shall be equipped with a corresponding set of circuit breakers and self-powered numerical relays. The RMU shall include potential-free contacts so as to connect to SCADA/DAS via RTUs, 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 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.
- All the Necessary interconnecting wires, cables, connectors, terminations and other wiring accessories such as terminal blocks required for interconnection between the RMU to connect to FRTU and interconnection cable between Tariff meters.
- The communication equipment such as modem
- The Static IP SIM card shall be provided by APEDCL
- The Supplier/Bidder shall supply touch proof cable jointing kits along with RMUs.
- The RMU shall be painted with epoxy powder based painting and thickness of the painting shall be not less than 17 microns.

8.1 RMU Design Features

All design features of the 33kV RMU as described in the supplier's bid and in the bid's reference materials, shall be fully supported by the equipment actually delivered. The key design features include those that relate to:

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

8.2 Maintainability, Expandability, and Life Span

Maintainability

The Utility intends to be self-reliant for RMU maintenance. To this end, the Supplier shall provide the support, documentation, and training necessary to operate the RMU.

Life Span

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

8.3 Outdoor Features

General

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, rain water and high levels of airborne dust.

The Outdoor RMU shall be conformably coated to meet these climatic conditions. In this respect, standards such as IEC 61171-200, covering equipment, systems, operating conditions, and environmental conditions shall apply. In particular, the RMU equipment shall have been type tested for IP54 from a national NABL accredited laboratory. Failure to conform to this requirement shall constitute grounds for rejection of the proposal.

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-ness.

Corrosion Protection

The switchgear and busbar shall all be contained in a stainless steel enclosure filled with SF6 at 0.3 bar relative pressure to ensure the insulation and breaking functions. Sealed for life, the enclosure shall meet the "sealed pressure system" criterion in accordance with the IEC 62271-1 standard (Clause No: 3.6.6.4 and 5.15.3): "A volume for which no further gas processing is required during its entire expected life". In addition, manufacturer shall confirm that maximum leakage rate is lower than 0, 1 % / year. It shall provide full insulation, making the switchgear insensitive to the environment (temporary flooding, high humidity,), IP54 degrees of protection in accordance with recommendation IEC 60529 Clause No: 14.2.7. It shall provide full insulation, making the switchgear insensitive to the environment conditions such as pollution, humidity, dust, etc.

The active parts of the switchgear shall be maintenance-free and the switchboard shall be low-maintenance. The switchgear shall provide IP2X degree protection with the exception of the 33 kV cable entrance and earthing plug where entrance is admissible. The tank shall be made of 3 mm ANSI 304 unpainted stainless steel. Except for stainless steel, all steel surfaces that are not galvanized shall be treated to protect against corrosion. (OR) **Shall be provided as per the manufacturer's type tested design and accordingly the respective type test to be submitted.**

As a minimum, corrosion treatment shall include the following procedures:

- The surface shall be cleaned to bare material by mechanical or chemical means.
- One or more phosphatizing or priming coats of paint shall be applied to the bare surface using a zinc-based or lead-based primer.
- A finish coat with epoxy powder paint only shall be applied over the primer. The coat thickness shall be of the order of 50 to 70 micrometers. The RMU should be of the final finish-coat as per manufacturer standard.

8.4 Immunity to Electrical Stress and Disturbance

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. **As per the IEC-62271/100-200 only.**

8.5 Nameplate Information

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

- Name of manufacturer and country
- Type, design, and serial number
- Rated voltage and current
- Rated frequency
- Rated symmetrical breaking capacity
- Rated making capacity
- Rated short time current and its duration
- Rated lightning impulse withstand voltage
- Employer's Contract number and date
- Name of the employer (APEPDCL)
- Month and year of supply
- **Name plate details shall include "Developed under RDSS" also along with other PO details**

Each RMU shall also exhibit a Danger Board to indicate the presence of high voltage (33000V).

8.6 Interconnecting Cables, Wiring, Connectors, and Terminal Blocks

The manufacture shall provide all interconnecting wires, cables, connectors, terminations and other wiring accessories such as terminal blocks required by the RMU to connect to FRTU and multifunction meters.

8.6.1 Metallic Cables

All metallic cables and wiring shall be of required cross-section solid or multiple strands of round copper conductors and have flame retardant insulation. All wiring shall be neatly laced and clamped.

All wire and cable connectors and terminators shall be permanently labeled for identification. All connection points for external cables and wires shall be easily accessible for connection and disconnection and shall be permanently labeled. Conductors in multi-conductor cables shall be individually color-coded.

8.6.2 RMU-FRTU Connectors

- For ease of installation and maintenance, the interconnection between the RMU and the FRTU, (FRTU is not in the scope of the bidder) in a separate enclosure shall be supported by having heavy-duty terminal blocks with screw type terminals shall be provided by the supplier for necessary cable terminations. In using a terminal block, no more than two cables or wires shall be connected to any of its individual terminals.
- Making 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.
- 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.

9.0 RMU characteristics

As a minimum, the RMUs shall be equipped with on-load break switches and a fault passage indicator (FPI), circuit breakers, and numerical relays for the protection of transformer feeders, The Load Break Switches and the Circuit Breakers used in the RMU shall be of SF6 insulated and vacuum type.

10.0 Each INCOMING load break switch will have the following

- 1No. Cable switches 33 kV, 630A, 25 kA.
- 1No. Mechanism for manual and motorised operation with integrated earthing switch
- 1No. Cable bushing 630A, standard C bushings.
- 1No. Voltage Presence Indication System (VPIS) - LED display.
- 1 No. Fault passage indicator for each load break switch with Suitable Setting range.
- 1No. Operation counters for each load break switch
- 1No. ON, OFF, EARTH indication on the front mimic of the panel.
- 1No. Cable box for termination of cable up to 3C 400 sq. mm.
- 1No. Cable entry hole
- 1No. 2NO + 2 NC contacts for load break switch
- 1No. 1No+1NC contacts for Earth switch
- 1No. Local remote control switch for each load break switch
- 1No. Set of 33 kV Cable Boots.

RMU load break switch shall have following Digital inputs and Digital outputs

Digital Inputs

- LBS Closed
- LBS Open
- Earth switch closed
- Earth switch open
- LBS local remote switch status

Digital outputs

- LBS Close
- LBS open

FPI Digital Input

- FPI operated

FPI Digital output

- FPI reset

Each OUTGOING Circuit Breaker will have the following

- 1 Circuit breaker 33 kV, 630A, 25 kA for 1 Sec
- 1 Mechanism for manual and motorised operation.
- 1 3 Over current and 1 Earth fault Self Powered numerical protection relay.
- 3 Ring core current transformers for protection of ratio 400-200/1-1 A, 2.5 VA, 5P10 for protection and 0.2S Class for metering. CT should be 0.2s with respective meter to be considered. PT should be 0.2 with respective meter to be considered.
- 1 Operation counters
- 1 4NO+4NC Auxiliary contacts for breaker
- 1 2NO+2NC Auxiliary contact for Disconnecter
- 1 1No+1NC contacts for Earth switch
- 1 Electronic Trivector meter of Class 0.2S with RS-232 Com port and MODBUS Protocol will be in the scope of bidder only. Supply of FRTU is not in the scope of bidder and for all other conditions shall follow technical specification.

- 8 Port LIU (Line Interface Unit) - 1 No
 - Fiber Optic Patch Chords -8 Nos.
 - 16 (8 + 8) Splicing Charges (Service)
 - FO to RJ45 Ethernet Media. Converter
- 1 Local remote control switch for each load break switch
 - 1 Capacitive voltage indication fixed type
 - 1 ON, OFF, TRIP indication on the front mimic of the panel.
 - 1 Cable box for termination of cable up to 1 No. 3C 400 sq. mm.
 - 1 Emergency Trip Push Button.
 - 1 Set of 33kV high voltage touch proof cable kits .

RMU breaker shall have following Digital inputs and Digital outputs

Digital Inputs

- CB Closed
- CB Open
- Earth switch closed
- Earth switch open
- Over current relay : operated
- Earth fault relay : operated
- CB local remote switch status

Digital outputs

- CB Close
- CB open

Protection relay

- Communication on Modbus thru RS232/485 port

Meter

- Communication on Modbus thru RS232/485 port

Other DI

- SF 6 pressure low
- Battery voltage low
- AC & DC fail

Bus connected PT module (Optional)

- 3Nos Single Phase 33KV / 110V, 25 VA burden
- 1 No 1 kVA Capacity Auxiliary transformer of ratio 33 KV / 230 V
- 1 No 24 V DC Battery Charger with batteries

Accessories:

- One operating handle
- One SF6 manometer with Auxiliary contact for monitoring status of GAS

10. General stipulations regarding the design and development of switchgear

10.1 Introduction

The RMU shall meet the criteria for compact, metal-enclosed switchgear in accordance with IEC 62271-200, IEC 60694.

10.2 Dielectric medium

SF6 gas is the preferred dielectric medium for 33 kV RMUs. Oil filled / Air insulated switchgear will not be considered. SF6 gas used for the filling of the RMU shall be in accordance with IEC 60376.

10.3 Earthing of metallic parts

There shall be continuity between the metallic parts of the switchboard and cables so that there is no electric field pattern in the surrounding air, thereby ensuring the safety of people. The substation frames shall be connected to the main earth busbar without dismantling any bus bars.

10.4 Earthing of the main circuit

The cables shall be earthed by an earthing switch with short-circuit making capacity; the earthing switch can only be operated when the switch is opening compliance with IEC standard 62271-102. The earthing switch shall be fitted with its own operating mechanism. The speed of the manual closing, driven by a fast-acting mechanism, is independent of the operator. Mechanical interlocking systems shall prevent access to the operating shaft to avoid all operator errors such as closing the earthing switch when the switch is closed and the earthing switch operating shaft shall have a padlocking facility. **Interlock to be provided in-line with safety at site. Ensure by OEM.**

10.5 "Network" Disconnectors:

They shall be maintenance-free, with breaking in low pressure SF6 gas. The position indicator shall provide positive contact indication and reliability of indication in accordance with IEC 62271-102 standard. The switches shall be of the type E2 "increased operating frequency" in accordance with IEC 60265-1 § 3.104 standard. They shall have 3 positions with individual operating mechanism for network disconnector and earth switch, open-disconnected, closed and earthed, and will be constructed in such a way that natural interlocking prevents unauthorized operations. The switches shall be fully mounted and inspected in the manufacturer's factory. Manual opening and closing will be driven by a fast-acting mechanism, independent of operator action. Each load break switch shall be suitable for an electrical operation in future in a specially reserved location, without any modification of the operating mechanism and without de-energizing the switchboard. The load break switch and earthing switch operating mechanism shall have a mechanical endurance of at least 1000 mechanical operations. The switches shall be fully mounted and inspected in the factory. An operating mechanism can be used to manually close the switch and charge the mechanism. RMU load break switch shall have following Digital inputs and Digital outputs.

Digital Inputs

- LBS Closed
- LBS Open
- Earth switch closed
- Earth switch open
- LBS local remote switch status

Digital outputs

- LBS Close
- LBS open

FPI Digital Input

- FPI operated

FPI Digital output

- FPI reset

10.6 Circuit Breaker:

The circuit breaker inside SF6 chamber shall be consisting of Vacuum circuit breaker confirming to latest IEC standards. The CB shall be maintenance free. **The offered RMU operating duty is O – 3min – CO – 3min – CO as per IEC.** The CB shall be three position independent operations. The disconnector operation is only possible when circuit breaker is open. The CB shall be suitable for up gradation for electrical operation in future. The CB shall be equipped with a self powered protection relay for over current and earth fault. The circuit

breaker mechanism shall have mechanical endurance of M2. It shall be fitted with a local system for manual tripping by an integrated push button. RMU breaker shall have following Digital inputs and Digital outputs

Digital Inputs

- CB Closed
- CB Open
- Earth switch closed
- Earth switch open
- Over current relay : operated
- Earth fault relay : operated
- CB local remote switch status

Digital outputs

- CB Close
- CB open

Protection relay

- Communication on Modbus thru RS232 port/**RS485 port**

Meter

- Communication on Modbus thru RS232 port/**RS485 port** **Supply of Electronic Tri vector meter will be in the scope of bidder only.**

Other DI

- SF 6 pressure low
- Battery voltage low
- AC & DC fail

10.7 RMU bushings and Cable terminations

10.7.1 Bushing

The bushing should be conveniently located for working with of 33 kV 3 core 400Sq mm XLPE cables specified and allow for the termination of these cables in accordance with the instructions supplied for the 630A M16 bolted connectors on line switches. The profiles of the cable connection bushings shall be in compliance with EN-50181 standards.

10.7.2 Cable clamps

A non Ferro-magnetic cable clamp arrangement must be provided for all network cables terminated on the RMU.

10.7.3 Padlocking facilities

Live load break switches and earthing switches can be locked in the open or closed position by means of padlocks introduced in holes of 8 mm diameter.

10.8 Voltage indicator lamps and phase comparators

Each function shall be equipped with a voltage indicator box on the front of the device 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. This device shall be in compliance with IEC 61 958 standard.

10.9 Self powered relay for RMU

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

General

- The Circuit Breaker in the RMU shall be fitted with a communicable-type, self-powered numerical relay. The relay shall have Communication port of RS 232(9 Pin D-Port) **RS485 port** using the MODBUS protocol.
- The numerical relay shall be self-powered and should provide Inverse Definite Minimum Time (IDMT) and Instantaneous protection characteristics. On this basis, the relay as a minimum shall provide:
- Three Phase Over current Protection (50/51)
- One Earth Fault Protection (50N/51N)
- The relay shall be provided with an input for remote tripping, which shall be realized via an electric output pulse even without presence of phase current. A flag indicator shall be installed for signaling the occurrence of trip conditions.

Features and Characteristics

- The numerical relay shall have the following minimal features and characteristics:
- It shall be housed in a flush mounting case and powered by the RMU power supply unit.
- It shall have three phases overcurrent elements and one earth fault element.
- IDMT trip current settings shall be 5-200% in steps of 1% for phase overcurrent and 10-80% in steps of 1% for earth fault.
- Instantaneous trip current settings shall be 100-3000% in steps of 50% for phase overcurrent and 100-1200% in steps of 50% for earth fault.
- Selectable IDMT curves shall be provided to include, for example, Normal Inverse, Very Inverse, Extreme Inverse, Long Time Inverse, and Definite Time. Separate curve settings for phase overcurrent and earth fault shall be supported.
- For IDMT delay multiplication, the Time Multiplier Setting (TMS) shall be adjustable from 0.01 to 1.0 in Steps of 0.01
- The relay shall also be provided with:
 - Alphanumeric Liquid Crystal Display (LCD)
 - Communications via a MODBUS RS232/RS485 port.
 - Parameter change capability that is password protected.
- **Shall be provided as per the manufacturer's type tested design and accordingly the respective type test to be submitted.**

10.10 Current Transformers

- 3 nos., ring type, single core CTs shall be provided in each circuit breaker for protection purposes.
- The CTs shall conform to IS 2705. The design and construction shall be sufficiently robust to withstand thermal and dynamic stresses during short circuits. Secondary terminals of CTs shall be brought out suitably to a terminal block, which will be easily accessible for testing and terminal connections.
- Further characteristics and features distinguishing CTs used for protection are listed as follows:
 - CTs for Protection:
 - Material: Epoxy resin cast
 - Burden: 2.5 VA
 - Ratio: 400-200/1-1 A
 - Accuracy Class: 5 P 20/0.2 S

- 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.
- **Protection & Metering CT's shall be Tape Insulated with ratio 400-200/1A, Burden 2.5VA, Acc CL 5P10 for protection & Acc CI 0.2s for Metering provided, PT should be CL 0.2 with respective meter to be considered.**

10.11 Fault Passage Indicators (communicable type with RS-232/ RS-485):

The FPI shall facilitate quick detection of faulty section of line. The fault indication may be on the basis of monitoring fault current flow through the device. The FPI should be self-powered and should have internal lithium battery for external indication and setting of FPI in the absence of current.

The FPIs shall include:

- Fault detection - Phase to phase and Phase to earth faults.
- One potential-free output contacts for hardwiring to RTUs. On this basis, the SCADA/DMS will be able to monitor phase / earth fault condition.
- Local fault indications - LCD display on FPI front panel along with LED indication on front panel of RMU enclosure.
- Multiple reset option –
- End of time delay (Adjustable from 2 to 16 Hrs)
- Remote reset (Via potential free input contact of FPI)
- Manual reset (Reset button on front panel of FPI)
- Automatic reset on current restoration.
- The characteristics of the FPIs shall include:
- **Phase fault thresholds configurable from at least 100/200 to 800/1200 A**
- **Earth fault thresholds configurable from at least 10/20 to 100/200 A**
- Multiple number of steps for adjusting phase and earth fault thresholds.
- Fault current duration range configurable from at least 40 ms to 100 ms in 20 ms steps and further 100 ms to 300 ms in 50 ms steps.
- Variations with respect to these characteristics may be acceptable as long as they prove applicable and provide the same or better flexibility.
- **Fault passage Indicator: Local fault indication – LCD display on FPI front panel along with LED indication on front panel of RMU enclosure (OR) The FPI may be mounted on RMU front fascia and have LED indication for Cable fault indication. But, it shall meet the respective load for RMU 3 way/5 way.**

10.12 Motors

The RMU shall be fitted with spring charging motors rated for 24 V DC of high insulation class allowing the circuit breakers and load break switches to be operated without manual intervention.

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

The motors along with the supplied control card and push buttons shall allow APEPDCL personnel to electrically operate the circuit breakers and load break switches at site without any modification of the operating mechanism and without de-energizing the RMU.

11 Voltage Transformers for Bus PT metering unit

The potential transformers shall be provided. These should be housed in a separate air insulated PT Panel, directly connected to the RMU through main bus. The burden per transformer shall

not be more than 25 VA and the voltage ratio shall be $33000/\sqrt{3} / 110/\sqrt{3}$ V. The accuracy class shall be 0.2.

HRC fuses shall be provided on the HV side.

The PTs shall be of cast epoxy-resin construction, and they shall conform to IS 3156. Their design and construction, in particular, shall be sufficiently robust to withstand the thermal and dynamic stresses during short circuits.

12 Power Supply

Each RMU shall be fitted with an own power supply, including Auxiliary transformer, batteries and battery charger, suitable for operating the motors of the On-load Isolators and Circuit Breakers. On this basis, the following operational specifications shall apply:

The Auxiliary power transformer shall be rated for 33000 V/230V, 1KVA, 50 Hz allowing for possible variation from 190 V to 300 V.

The power supply unit shall conform to the following requirements:

- Input: 230 V AC nominal from the RMU's auxiliary power transformer allowing for possible variations from 190 to 300 V AC
- Output: Stable 24 V DC.
- Batteries: 24 V DC (2 Nos. of 12 V DC each)

The 24 V DC batteries shall have sufficient capacity to supply power to the following devices with a nominal backup of 4 hours:

- RMU's motors for a minimum of five (5) operations
- RMU's trip coils, close coils, FPI (in case required).

The batteries shall be of sealed lead acid VRLA or dry type and shall have a minimum life of **36 months from the date of supply** at 45°C.

- The battery charger shall be fully temperature compensated.
- 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 values with set values (e.g., internal resistance, voltage, etc.).
- 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:
 - Low battery voltage
 - High battery voltage
 - Battery failed
 - Battery charger overvoltage
 - Grounded battery/battery-charger

12.1 Functions of the monitoring and control enclosure

The monitoring and control enclosure will meet the following main requirements:

- Supply of FRTU is not in the scope of bidder and for all other conditions shall follow technical specification.
- Monitoring and control of medium voltage cubicles.

- Detection of ampere metric faults, adjustable for each feeder.
- Load current measurement on the line fitted with a fault detector.
- Data transmission to the remote control centre.
- Chronological time-stamped event recording.
- Energy supply and storage with 9-hour autonomy in the event of mains failure for: 24 V DC motor drives.
- Transmission equipment.
- Control unit.
- **Function of the Monitoring and control enclosures: Load current measurement on the line (optional) fitted with a fault detector/indication. But, it shall meet the respective load for RMU 3 way/5 way.**

12.2 It will be possible to view the most important information locally on the front panel of the enclosure and remotely from the control centres. It will be possible to retrieve and display on a laptop PC the time-stamped events recorded at the enclosure. It will also be possible to retrieve this information from the remote control centre. The minimum storage capacity will be 50000 events. The control enclosure will be used to operate the cubicles in remote or local control mode.

- In remote control mode, the enclosure will ensure:
- Transmission of remote measurements and time-stamped events.
- Possibility of electrical remote control.
- Inhibition of local electrical control pushbuttons.

In local mode, the enclosure will ensure:

- Transmission of remote measurements and time-stamped events
- Possibility of local electrical control of opening and closing operations by simultaneously pressing a pushbutton to select the unit to be operated and a validation pushbutton.
- Inhibition of opening/closing remote control.

12.3 Fault detection

- The fault detection characteristics will be as follows:
- Phase-to-phase fault detection: between 100 and 750A in increments of 50A.
- Earth fault detection: between 20 and 160A in increments of 5A.
- Fault processing time between 50 and 500 ms in increments of 25ms.

A detected fault can be cleared:

- When the voltage is restored: configured channel by channel.
- After a timeout: configured channel by channel from 0 min to 120 min in increments of 15 min.
- By pressing a pushbutton on the local control panel.
- By remote control from the control centre.
- Externally (dry loop).

The currents will be measured using an opening and self-blocking current sensor with an internal diameter of less than 45 mm. The load current associated with fault detection on the line will be displayed locally and transmitted to the remote control centre.

12.4 Energy workshop

- Power from the energy workshop will be sufficient to supply 24 V to at least all the switch cubicles, the radio and the electronics in the enclosure. It will be possible to configure the 24 V DC motor drive supply voltage (on site).
- The 24 V transmission output will be able to supply a conventional radio without a battery to inform the remote control centre of a battery failure.
- The standby energy will be provided by a 24 V 40AH battery with a minimum autonomy of at least 9 hours for 10 opening and closing cycles.
- The batteries will be checked at regular intervals by the slave station and an alarm will be generated and transmitted to the remote control centre in the event of a fault.
- The workshop will be protected against over voltages and over currents. The dielectric characteristics of the supply voltage input in accordance with IEC 60 25564 will be as follows:
 - Insulation (50 Hz/1 min): 10 kV
 - Impulse wave (1.2/50): 20 kV
 - The voltage available in the station is single-phase 230 V AC.

The bidder/vendor should confirm the sections 12.5 to 12.12 mentioned below that these latest technology are provided. The vendor shall guarantee for necessary demonstration at site as per APEPDCL requirement.

12.5 Time-tagged data archiving

All the archived data will be retrieved locally and remotely by means of the configuration and operating software supplied with the control unit. The data will also be downloaded locally or remotely to a PC as a .CSV file. Event and measurement time-stamping will be accurate to one millisecond and the discrimination between two events will be 10ms.

12.5.1 Time-stamped event archiving

Any change of information status will generate a stored time-stamped event. The minimum storage capacity of the events to be transmitted to the remote control centre will be 500 events.

12.5.2 Measurement archiving

Each measurement can be configured to be archived if required. A measurement declared archived can be stored:

- At regular intervals (the interval can be configured): mean or sampled value.
- When the high and low thresholds are exceeded (the thresholds can be configured).
- On dead band (X% customizable).
- Daily: min. and max. Daily values (the storage period can be configured: 24 h, 7 d, and 14d).

The measurement storage conditions (configured individually) can be combined. The minimum storage capacity will be 20000 measurements.

12.6 Communication with the remote control centre

12.6.1 Communication protocol

The control unit shall have following communication protocols:

- IEC 870-5-101 / 104 protocol to transfer information to control center SCADA.
- Modbus protocol to communicate with field IED's / Energy meters on RS485.

12.6.2 Events transmission

It will be possible to configure each time-stamped event to correspond to the appearance or disappearance of an "alarming event" or an "alarming" closure failure. A time-stamped event declared to be "alarming" establishes communication with the remote control centre.

12.6.3 Measurement transmission

It will be possible to configure each measurement to be transmitted spontaneously to the remote control centre when:

- The dead band is exceeded: X% variation of the value measured; X% can be configured.
- The high or low threshold is exceeded: the threshold can be configured in Amps.

12.6.4 Communication ports

The control unit shall have following communication ports:

- One Ethernet port for interfacing with the IP compatible communication equipment.
- One RS232 Console port.
- One RS485 port to connect field IED's / Energy Meters on RS485.
- One RS232 port for connecting external modem.

Operation of each channel will be defined by configuration. The channels will be used as follows:

- Out of service: when the channel is not used, not present or temporarily out of use
- Normal: corresponds to the main communication channel.
- Main: corresponds to the 1st channel (normal) used during normal / standby operation.
- Standby: corresponds to the 2nd channel used during normal / standby operation.
- Symmetric: corresponds to the 2 channels used during normal / standby operation, without operating priority on either of the channels. The channel in service remains active so long as communication is present on that channel. If communication disappears from that channel, changeover to the other channel takes place provided that communication is present on the other channel.
- Store & Forward: the messages received on the main channel that are intended for another FRTU that cannot be accessed directly from SCADA are re-sent over the same channel in order to send to that other FRTU the message intended for him.
- Test: this link is used to send certain information to other FRTUs nearby at a fixed carrier frequency so as to be able to perform maintenance operations (adjustment of antenna position, etc.).

12.6.5 Local communication networks

The control unit will have RS485 (Modbus) port & TCP/IP (IEC-104) port for communication with the station equipment:

- Power monitoring unit
- Protection relay

The Modbus and IEC-104 protocol will be open; it will be programmed by the control unit configuration. Information from this slave equipment can be stored and dated when the status changes (can be configured for each event).

12.7 Remote configuration and operating tool

Data will be configured using a PC connected to the control unit via an Ethernet/Fiber Optic and/or USB port. Configuration will mainly be effected by downloading a file prepared in the workshop. It will therefore be possible to:

- prepare the configurations off-line and save them on a PC,
- restore a control unit configuration using a PC,
- save a control unit configuration to a PC.

It will also be possible to configure data remotely using the operating and maintenance software supplied with the equipment in the case of GMS, GPRS and Ethernet networks.

This software will not require a special license and can be used and copied freely.

Login and access to the various functions will be protected by a user name and password. Several access levels can be configured.

12.8 Diagnosis

The diagnosis pages will be used to retrieve station, switch and system data:

- Measurement and status display: this page is used to view in real time the TSS, TSD and TM status for each switch controlled by FRTU.
- Archived event retrieval.
- Each status log has its own specific page.
- Users can acknowledge status locally.
- Maintenance.
- Information about the unit (name of the unit, date of the last backup).
- Information about the software used.
- Protocol analyser. This analyser is used to observe the frames exchanged with the remote control centre to facilitate maintenance operations.

12.9 Data loading

- Loading a configuration from a file saved on a PC.
- Loading a new version of the communication card or protocol software with protected switching and the possibility of reverting to the original version.

12.10 Saving parameters and archived data:

- Unit configuration.
- Events and measurements archived as a Word or Excel file.

12.11 Parameter and alarm configuration

- Control module parameters
- Substation name
- Delayed no-voltage alarm
- Fault detector parameters
- Automation parameters
- Communication module parameter
- General parameters (type of protocol, use of ports, type of modem, etc.).
- Protocol parameters: interoperability table, alarm
- Communication parameters

12.12 Switch connection

Orders and information will be transmitted from the switchgear interface to the switch control unit via a single cable connected to the enclosure by a rack-out connector mounted on the

lower part of the enclosure. Each connector has a fail-safe device to prevent reversal between the various electrical controls.

The socket can be "plugged" for simulation and test purposes.

12.13 Capacity

The Standard FRTU shall be capable to monitor and control up to 4 ways RMU. Further expansion of FRTU must be possible.

12.14 List of information to be provided

The slave stations will process at least the following information for remote indication and/or local display purposes:

- open/closed position of each MV switch,
- earthing status of each MV direction,
- Absence of AC voltage,
- Local/remote control operating mode,
- Detection of phase-to-phase or earth fault current flow,
- load current measurement
- Charger fault
- Battery fault
- Motor drive 48 V supply fault
- Internal fault
- Detailed diagnosis of the status of the uninterruptible power supply (charger, batteries).

12.15 Additional Capabilities

Supply of FRTU is not in the scope of bidder and for all other conditions shall follow technical specification.

The FRTU must be capable to isolate the faulty part of the grid and restore healthy part of the ring network for an alternate power source automatically without interaction with upstream control center. (Referring the concept of Self Healing Grid – SHG).

In order to guarantee a high level of safe operation, the system has to be proposed as a standard solution, pre-tested in manufacture, and configured on site by defining the substation quantity per loop and the communication address of each RTU.

The SHG automation scheme shall restore the MV-rings only one time after a short circuit. Any short circuit caused during the repair period of the first cable failure is not handled by the SHG and will need to be isolated manually and/or by remote commands from SCADA.

The logic shall be distributed in associated FRTU in the MV/LV substation.

The FRTU in the different substation shall be communicating together with peer to peer in order to take locally the decision to control the switchgears.

The FRTU with SHG function shall include following:

- Split toroid type current sensors for current measurement on the MV or LV network
- Voltage measurement modules.
- Fault passage indicators, voltage presence indicator and Voltage detectors.
- Software (logic blocks) in the FRTU for Self Healing logic (FDIR)

13 Safety of people

Any accidental overpressure inside the sealed tank will be limited by the opening of a pressure limiting device in the lower part of the enclosure. Gas will be released to the bottom and rear of the switchboard away from the operator. Manufacturer shall provide type test report to prove compliance with internal fault, according the relevant standards.

14 Front plate

The front plate shall have an IP 3X degree of protection. The front shall include a clear mimic diagram which 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 manufacturer's plate shall include the switchboard's main electrical characteristics.

15 Cable insulation testing

The Cable testing is possible without disconnecting the cables from the bushing. It shall be preferable to carry out the phase by phase testing. The maximum test voltage shall be less than 5 kV DC for 15 minutes.

16. Finishing

The device shall be fully designed for use in a hot, humid atmosphere and shall be low-maintenance. At least two lifting rings shall be installed on the top of the switchboards for handling.

17. Type and routine tests

According to this specification and IEC recommendations, the following type test certificates shall be supplied:

- Impulse withstand test,
- Temperature-rise test,
- Short-time withstand current test,
- Mechanical operation test,
- Checking of degree of protection,
- Switch, earthing switch making capacity.
- Switch, breaking capacity.
- Internal arc withstand
- 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 routine tests carried out by the manufacturer shall be backed by test reports signed by the factory's quality control department. They shall include the following:

- Conformity with drawings and diagrams,
- Measurement of closing and opening speeds,
- Checking of filling pressure,
- Checking of gas-tightness,
- Dielectric testing.
- Main circuit resistance measurement.
- Fuse combination mechanical checking.

18. Quality

When requested by the customer, the supplier shall provide proof that he applies a quality procedure in compliance with the standard, namely:

- Use of a quality manual approved and signed by a top management representative,

- Periodic updating of the manual so that it reflects the quality control procedures in effect,
- ISO 9001 and ISO 14001 certification.

19. TESTS

- 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. The type test produced by supplier shall be only from reputed testing laboratories such as CPRI & ERDA from India and KEMA, Volta, KERI, CESI etc from remaining part of the globe. **Type test to be conducted in NABL or international accredited 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.
- Prior to acceptance testing, the supplier shall prepare and submit a detailed quality assurance plan and routine/ inspection test plan for review and approval by the APEPDCL.
- The manufacture must have in house NABL accredited testing lab for carrying out internal inspection and testing inside the factory witness by the utility. All the equipment used must be up to date and calibrated by reputed agency.

20. Routine Test

The tests shall be carried out in accordance with relevant standards but not necessarily limited to the following:

- Withstand voltage at Power Frequency for all current carrying parts including wiring
- Measurement of resistance of the main circuit Non-Extensible / extensible RMU
- Leakage test
- Withstand power frequency voltage on auxiliary circuits
- Operation of functional locks, interlocks, signaling devices and auxiliary devices
- Suitability and correct operation of protections, control instruments and electrical connections of the circuit breaker operating mechanism (primary & secondary injection)
- Verification of wiring
- Visual Inspection Routine test shall be carried out on all equipment such as circuit breakers, current transformers, relays, etc. as per relevant standards.

The Employer reserves the right to witness routine tests prior to dispatch. The contractor shall give 15 days' notice for such tests. In case the tests are not to be witnessed by the Employer, will communicate the same within 7 days of receipt of such notice.

21 Acceptance Tests

The acceptance tests shall include all the routine tests mentioned above and also demonstration of tripping through the relay by secondary injection tests.

22 GUARANTEE:

The period of Guarantee will be 5 years (five years) the date of commissioning.

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS FOR RING MAIN UNIT

Sl.No.	Description	As per Tenderer
(A)	RING MAIN UNIT PANEL	
1	Manufacturer's Design / Type ref/Model.	
2	Material used for making the body of the enclosure	
3	Standards of manufacturing	
4	Whether painting for RMU metal enclosure is done as per high standards.	

Sl.No.	Description	As per Tenderer
5	Whether the enclosure is fire resistive, anti-corrosive	
6	Sufficient space for inspection, testing, e	
7	Earthing arrangements	
8	Whether the enclosure are designed to withstand the in all weather conditions (Seashore area)	
9	Over all dimensions of the RMU enclosure (L x B x H)	
10	Gauge of the Material used for the fabrication of the RMU enclosure	
11	Whether the RMU enclosure is manufactured as per IEC/IS standards to hold SF6 gas without leakage	
12	Whether the RMU enclosure made provision for sensors for temperature compensated pressure. measurement in the relevant gas compartment to monitor the pressure of SF6 GAS	
13	Whether the RMU enclosure is sealed pressure system.	
14	Weight of RMU complete with operating mechanism for 3way & 5way separately.	
15	RMUs are provided with necessary take off terminals	
16	The gas chamber is made of which material and thickness	
(B)	For Vacuum circuit breakers :	
1	Maker's Name and Address	
2	Continuous rating current at 40 deg C	
3	Fault Breaking capacity	
4	Fault Making capacity	
5	Short time current withstand capacity	
6	No. of poles	
7	Maximum temp. rise of contacts at normal rating and frequency	
8	Method of closing and Operating Mechanism	
9	Min no. of Mechanical operations	
10	Type & Designation	
11	Standards	
12	Rated service voltage	
13	Frequency	
14	Installation	
15	Duty	
16	No. of breaks per phase	
17	Type of main contacts	
18	Minimum clearances in SF6	
	i) Between Poles	
	ii) Between live parts & earth	
	iii) Between fixed and moving contacts in the open position	
19	Vacuum bottle	
	Make:	
	Vacuum pressure(Torr)	
	Rated current	

Sl.No.	Description	As per Tenderer
20	CB open time	
21	CB closing time	
22	Short time current capacity for 1 sec.	
23	Cable charging interrupting current	
24	Magnetizing interrupting current	
25	Spring charge Motor rated voltage	
26	Emergency trip/open push button	
27	Whether battery charger conventional type	
28	Battery Charger cap / rating	
29	Battery type and capacity	
(C)	Load BREAK SWITCHES	
1	Continuous rating current at 40 deg C	
2	Fault Breaking capacity	
3	Fault Making capacity	
4	Short time current withstand capacity	
5	Total length of break per pole	
6	Type of arcing contacts and arc	
7	control device	
8	Steady hydraulic test pressure tank can withstand for one minute without distortion.	
9	Operating mechanism and type of closing.	
10	Type of motor and details	
11	Fault passage indicators	
	a) Type/model	
	b) Self powered Yes/No	
	c) Current readings	
	d) Phase currents	
(D)	Earth switch	
1	Operating mechanism for close and open	
2	Fault making cap of 50KA	
3	Min no. of operations at No load mechanical endurance.	
4	Making cap Endurance of Earth switch as per IEC 62271-102)	
5	Switching in dielectric medium	
6	Pad lock facility for all Earth switches.	

ANNEXURE – II
SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS
FOR 33KV RING MAIN UNIT OUTDOOR TYPE (SF6)

Sl.No.	Description	As per Tender
	BUS BAR	
1	Material & Grade	
	a) Cross Sectional area (mm)	
	b) Size (mm)	
2	Continuous current	

Sl.No.	Description	As per Tender
	a) Standard	
	b) At site conditions and within cubicle.	
3	Short time current for 1 sec (kAmps)	
4	Minimum clearance from bare bus bar connection	
	a) Phase to Phase (mm)	
5	SF6 gas pressure	
6	Reference standard	
7	Maximum temperature rise over ambient oC)	
	b) Phase to earth (mm)	
8	Bus bar provided with	
	a) Insulation sleeve	
	b) Phase barriers	
	c) Cast Resin shrouds for joints	
9	Bus Bar connection	
	a) Silver plated	
	b) Made with anti oxide grease	
10	Bus bar support spacing (mm)	
11	Bus support insulators.	
	a) Make	
	b) Type	
	c) Reference standard	
	d) Voltage Class (kV)	
	e) Minimum creepage distance (mm)	
	f) Cantilever strength Kg/mm.	
	g) Net weight (Kg).	

ANNEXURE-III

GUARANTEED TECHNICAL PARTICULARS FOR CURRENT TRANSFORMERS for CBs with 400-200/1-1A

Sl.	Details	As per APEPDCL	As per Tenderer
1	Type	Ring type and resin cast/tape wound	
2	Manufacturer's Type & designation	—	
3	Rated Voltage/Highest voltage	33 KV/36KV	
4	Rated Primary current	400-200	
5	Rated Secondary current	Core-I : 1A Core-II: 1A	
6	No. of cores (Secondary core details)	Two	
7	Turns ratio	400-200	
8	Rated Output in VA	a. Core I : 2.5VA, Core II :2.5VA	
9	Class of Accuracy	Core I : 5P10,CoreII:0.2S	
10	Accuracy Limiting factor	10 for protective core	
11	Knee point voltage of PS cores	—	
12	Maximum excitation current for PS cores.	—	

Sl.	Details	As per APEPDCL	As per Tenderer
13	Method of ratio change and secondary connection details & connection diagram.	Secondary Tapping	
14	Secondary voltage	Core-I: Core-II-	
15	Secondary Limiting Voltage	Core-I:15V Core-II-5V	
16	Short time current	25 KA/3Sec	
17	Rated current dynamic (Peak Value)	-	
18	Rated continuous thermal current temperature rise over ambient.	As per IS: 2705	

ANNEXURE-IV
GUARANTEED TECHNICAL PARTICULARS FOR PROTECTION RELAY

Sl.	Details	As per APEPDCL	As per Tenderer
1	Type	Numerical communicable four element relay of 3O/L+1E/L with high set	
2	Manufacturer's Type & designation	–	
3	Application standard	-	
4	Whether compatible for 1 A CT Secondary		
5	Display	Whether Alpha numeric LCD	
6	Reset time	0-100 msec	
7	Burden of relay	< 1VA	
8	Maximum and Minimum, operating ambient air temp.	50 deg C	
9	Certificate of Proof for Electro Magnetic Interference.	Yes	
10	Relay IDMT curves	SI ,LI, EI,VI, DMT etc ,	
11	O/L Current setting range	5-200% in steps of 1%	
12	E/L current setting range	5-100% in steps of 1%	
13	O/L time multiplier settings	0.01 to 1 insteps of 0.01	
14	E/L time multiplier settings	0.01 to 1 insteps of 0.01	
15	O/L high set settings	100-2000% in steps of 50%	
16	E/L high set settings	100-1500% in steps of 50%	
17	Type of protocol	MODBUS with Rs232	
18	Master trip self reset relay for CBs	Electromagnetic	
19	Display of phase and neutral currents	Both local display and <u>remote monitoring</u>	
20	Recorded events	5 Nos. Latest Fault recorded events with time stamping with indicating flags and also remote monitoring	

ANNEXURE – V
Interlocks and safety:

Sl.	Description of interlock	Requirement as per EPDCL	As per Tenderer
1	Load break switch & respective Earth switch	Mechanical interlock with only one in 'close' condition at a time	
2	Circuit breaker & respective earth switch	Mechanical interlock only one in 'close' condition at a time	
3	Load break switch & respective Earth switch	Mechanical interlock with only one in 'close' condition at a time	
4	Circuit breaker & respective earth switch	Mechanical interlock only one in 'close' condition at a time	
5	Prevent the removal of respective cable covers if load break switch or circuit breaker is 'ON'	Electrical / Mechanical	
6	Prevent the closure of LBS/CB if respective cable cover is open	Electrical / Mechanical	
7	Cable test plug for LBS/CB is accessible only if Earth switch connected to earth	Mechanical	
8	Prevent motorized operation of LBS / CB during manual operation	Electrical signal shall cut-off completely during manual operation. If LBS fail to operate, the supply to motor shall be disconnected after certain time period to prevent burning of motor due to continuous supply.	
9	Explosion vents for safety		
10	Other foolproof interlocks if any	--	