EDMS 02-102-1

Technical specification for
12 kV Ring Main Unit (GIS / AIS)

Indoor/Outdoor Installation

Issue: October-2021 / Rev- 1

- **This revision contains option items that must be selected by EDC before bidding.**
- **EDMS 19-400 for HRC Fuses shall be attached if applicable.**
- **EDMS 17-400 for MV CTs shall be attached if applicable.**
- **EDMS 17-401 for MV VTs shall be attached if applicable.**
- **EDMS 20-305 for Indirect Smart Meters shall be attached if applicable.**

CONTENTS

GLOSSARY:

EEHC: Egyptian Electricity Holding Company.

EDMS: Egyptian Distribution Material Specifications.

MV: Medium Voltage.

RMU: Ring Main Unit.

GIS: Gas Insulated System.

AIS: Air Insulated System.

A.C.: Alternating Current.

D.C.: Direct Current.

IEC: International Electrotechnical Commission.

NO: Normal Open.

NC: Normal Close.

VDS: Voltage Detecting Systems.

VPIS: Voltage Presence Indicator

EMS: Energy Management System.

DMS: Distribution Management System.

DA: Distribution Automation.

SA: Substation Automation.

RTU: Remote Terminal Unit.

ADMS: Advanced Distribution Management System.

SCADA: Supervisory Control and Data Acquisition.

C.T.: Current Transformer.

V.T.: Voltage Transformer.

SF6: Sulfur Hexafluoride

IP: Ingress Protection.

IK: Degree of Protection against Mechanical Impact.

C.B.: Circuit Breaker.

L.B.S.: Load Breake Switch.

H.R.C.: High Rupture Capacity.

…EDC: …. Electricity Distribution Company.

LSC: Loss of Service Continuity.

IAC: Internal Arc Classification.

AFLR: Access Front Lateral Rear.

LPCT: Low Power Current Transformer

FPI: Fault Passage Indicator.

TCP: Transmission Control Protocol.

O.C.: Over Current.

E.F.: Earth Fault.

S.C.: Short Circuit.

IDMT: Inverse Definite Minimum Time.

DT: Definite Time.

XLPE: Cross-linked polyethylene.

HMI: Human Machine Interface.

RTC: Real time Clock.

1. SCOPE

This specification specifies the minimum technical requirements for design, supply, engineering, manufacturing, testing, inspection, packing, and performance of indoor/outdoor gas-insulated (AIS/GIS) ring main unit (RMU) intended to be used in a 12 kV medium-voltage system. The RMU shall be motorized and ready to be controlled remotely by using integrated automation solution via the SCADA in the future. All required modifications and retrofit must be deployed on the site.

2. REFERENCE

The RMU equipment should comply with IEC listed hereafter. In no way does this specification supersede the relevant codes except when the requirements herein are more stringent. All cases of conflicts should be immediately brought to the tenderer's attention.

3. APPLICABLE STANDARDS

Unless otherwise specified, the RMU should comply with the latest edition of IEC publications:

3.1.	IEC 62271-1	Common Specification for alternating current switchgear and control gear
3.2.	IEC 62271-200	AC metal-enclosed switchgear and control gear for rated voltage above 1 kV and up to and including 52 kV.
3.3.	IEC 62271-100	High-voltage alternating-current circuit breakers
3.4.	IEC 62271-102	Alternating current disconnectors (isolators) and earthing switch.
3.5.	IEC 62271-103	Switches for rated voltages above 1 kV up to and including 52 kV
3.6.	IEC 62271-105	Alternating current switch-fuse combinations for rated voltages above 1 kV up to and including 52 kV.
3.7.	IEC 62271- 206	Voltage presence indicating systems for rated voltages above 1 kV and up to and including 52 kV
3.8.	IEC 61243-5	Live working - Voltage detectors - Part 5: Voltage detecting systems (VDS)
3.9.	IEC 61958	High-voltage prefabricated switchgear and control gear assemblies -

		Voltage presence indicating systems
3.10.	IEC 61131-5	Programmable controllers – communication.
3.11.	IEC 6100-4	Electromagnetic compatibility measurements and testing.
3.12.	IEC 61508	Functional safety of electrical/electronic/programmable electronic safety-related system.
3.13.	IEC 60255	Electrical relays
3.14.	IEC 60694-2.2	Common specifications for HV switchgear & control gear)
3.15.	IEC 61869-1	Instrument transformers - General requirements)
3.16.	IEC 61869-2	Instrument transformers - Additional requirements for CTs)
3.17.	IEC 61869-3	Instrument transformers - Additional requirements for inductive VTs)
3.18.	IEC 62271-206	HV switchgear and control gear - Voltage presence indicating systems for rated voltages above 1 kV and up to and including 52 kV.
3.19.	IEC 60947-5-1	Control switches (low-voltage switching devices for control an auxiliary circuits, including contactor relays). - Part 1: General requirements
3.20.	IEC 60376	Specification of technical grade sulfur hexafluoride (SF6) for use in electrical equipment.
3.21.	IEC 60529	Degrees of protection provided by enclosures (1P Code).
3.22.	ISO 2063	Metallic coatings, protection of iron and steel against corrosion- metal spraying of zinc and aluminum.
3.23.	CENELEC EN 50180	Bushings above 1 kV up to 52 kV
3.24.	CENELEC EN 50181	Plug-in type bushings above 1 kV up to 52 kV
3.25.	IEC 60282-1	High-voltage fuses - Part 1: Current-limiting fuses
3.26.	IEC 60086-2	Primary batteries - Part 2: Physical and electrical specifications

In case of any deviation from the listed standard, it should be indicated in the list of deviations list submitted by the tenderer.

4. General Requirements :

4.1. General

The Ring Main Unit should have different configurations that consisting of a combination of various modules to meet the electricity distribution company requirements. Some of these modules are listed below and not limited to:

- [X] Switch disconnector with Earthing switch module.
- [Y1] Circuit breaker with Earthing switch module.
- [Y2] Switch-fuse disconnector with H.R.C fuses with Earthing switch module.
- [M1] Metering tariff module consists of 3 current transformers and 3 voltage transformers.
- [M2] Auxiliary supply module consists of Voltage transformer: Single/ Double pole.in case of no low voltage feeding.

Note: [X], [Y1 or Y2], and [M1 or M2] should be defined according to ….EDC requirements.
: The RMU may be extendable as option according to….EDC requirements).

4.2. ENVIRONMENTAL CONDITIONS

The electrical and mechanical properties of the required RMU should be guaranteed under the following environmental conditions:

Ambient temperature	-5°C to +45°C (50°C as option according to ….EDC)
Average relative humidity	95 % over a period of 24 h and 90 % over a period of one month.
Altitude	Up to 1000 m above sea-level

4.3. GENERAL TECHNICAL DATA

The required RMU should have a safe behavior and meet all requirements given below:

Rated (Maximum operating) voltage	12 kV
Nominal operating (Service) voltage	11 kV
Power frequency R.M.S. withstand voltage (1 min)	28 kV
Impulse withstand voltage (1.2/50) µs peak	75 kV.
Rated frequency	50 Hz.
Color	Light grey (Preferred)

IP Class (Gas Tank)	IP67
Electrolytic Copper purity	≥ 99.9 %
Copper Conductivity	not less than 57 MS/ m

4.4. DESIGN CRITERIA (Indoor Use)

- A 12kV RMU for indoor use. And shall be installed inside a building/a kiosk on the ground. It consists of a feeder switch, cable compartment, and base frame.
- Each part of RMU completed with all fittings is capable of withstanding the mechanical stress in case of operation, electromagnetic force in case of short circuit. It will not open or close by gravitation, vibration, and so on.
- The RMU structure of the switchboard should consist of a heavy-duty structural steel framework of substantial sections and dimensions to carry safely the mounted items.
- The RMU structure should be from rolled steel sheets not less than 2 mm thickness before any coating or painting for indoor use and with a mechanical impact class not less than (IK 07) and should certifies by type test.
- The RMU should be of electrostatic powder with thickness of 60:80 microns everywhere.
- For GIS: The switchgear shall be metallic partitioning classification (PM), except for fuse module may be (PI).
- The switchgear loss of service continuity category is LSC2 for [x] and [y] modules.
- The load break switch, as well as earthing switch, should be operated using a handle at the front (one handle must be provided with each switchboard)
- The positions of the load break switch and earthing switch should be indicated by a movable obvious color with suitable clear current mimic position indicator gives the position of the switches and breaker at the front of the switchboard.
- The incoming / outgoing cables shall enter the switchgear from the bottom; where these cables are XLPE insulated, 12/20KV and having aluminum conductors up to 3 × 400 mm^2 (or as ….. EDC requirement).
- The Load Break Switches of the ring main unit should be motorized for remote operation and control without interruption of supply.
- Manual operation without removing the motor mechanism should be possible in case of failure of the motor.

- The RMU should withstand the internal arc test, as a mandatory type test, which is intended to verify the effectiveness of the design in protecting persons in case of an internal arc (IAC).
- The internal arc class of the RMU shall be IAC AFL 16 kA for 1 Sec including the cable compartment as mandatory. The ventilation should be provided with down/upward ventilation (as optional according to...EDC requirements).
- The gas tank should have a pressure relief.
- A suitable base for RMU shall be provided (as optional according to …EDC requirements).
- The RMU shall be designed such that the position of the different devices shall be visible to the operator on the front of the switchboard and easy to operate & prevent access to all live parts during operation without the use of the RMU special tools.
- 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 requirements.
- Each module shall have a facility to carry out high voltage tests and current injection tests for the cables terminated on them. Disconnection of cables for testing purposes is not accepted.
- The RMU should have suitable support facilities to be lifted from the top and wooden pallet to be lifted from bottom for safe transport.

4.5. Switch disconnector (Load break switch)

- Switch disconnector shall be gas load break switch, 12kV - 630A, manual drive and motorized with its spring mechanism, used for the cable feeders.
- Switch disconnector shall have three positions; ‘ON’, ‘OFF’, and ‘Earth’. The main switch and earth switch should have two independent manual operating mechanisms to prevent simultaneous closing of the main switch and earth switch.
- The manual switching operation shall be using an operating handle. Switching speed shall be independent of the handle speed.
- The switch disconnector shall have the retrofitting capability on the site for the operating mechanism and associated equipment.
- Switch disconnector shall be designed for interrupting the full rated current, interrupting small inductive current for unloaded transformer or capacitive current for cable or overhead lines load breaking, and fault-making.

- The earth switch contacts shall be designed to close into a fault and shall have the same short circuit capacity as the main contacts.
- Necessary auxiliary contacts for controlling, signaling& free contacts (2NO-2NC) at least in low voltage compartment and all accessories needed for operation should be provided for each of the switch disconnector and earth switch.
- The operating handle shall be designed to prevent the opening of the switch-disconnector or the earth switch after closing

Switch disconnector	Rated Voltage	12 kV
	Rated normal current at 40 C°	630 A
	Short-time withstand current (I_K)	25 kA for 1 second
	Making capacity	62.5 kA
	Mechanical endurance	M1: (1000 operating cycles)
	Electrical endurance	E3, C1
Earth switch	Short-time withstand current	25 kA for 1 S
	Making capacity	62.5 kA
	Mechanical endurance	M0: (1000 operating cycles)
	Electrical endurance	E2

4.6. Switch-Fuse disconnector:

- The LBS shall be gas insulated - load break switch, 12kV - 200A, manual drive and motorized with its spring mechanism
- It used for the transformer protection and complete with three high rupture capacity (H.R.C) fuses and the rating of fuse should be according to transformer rating and should be specified by ….EDC on every tender.

- The high rupture capacity (H.R.C) fuses shall be designed according to the latest revision of EDMS 19-400.
- The LBS shall have a 3-position ‘ON’, ‘OFF’, and ‘Earth’ the main switch, and the earth switch should have two independent manual operating mechanisms to prevent simultaneous closing of the main switch and earth switch.
- The manual switching operation shall be using an operating handle. Switching speed shall be independent of the handle speed.
- The switch fuse disconnector shall have the retrofitting capability on the site for the operating mechanism and associated equipment.
- The operating handle shall be designed to prevent the opening of the switch-disconnector after closing.
- The fuse holder frames should fit with an automatic opening device that functions even if only a single fuse blows.
- The fuse striker mechanism should trip the switch in case of any failure (The automatic fuse contact shall be designed to open into a fault) and shall have visual and signal indications.
- Necessary auxiliary contacts for controlling, signaling& free contacts (2NO-2NC) at least in low voltage compartment and all accessories needed for operation should be provided for each of the switch-fuse disconnector and earth switch.
- An indicator on the front side to present the charging spring status (Charged – Discharged).

Switch fuse disconnector	Rated Voltage	12 kV
	Rated normal current at 40 C°	200 A
	Short-time withstand current (I_K)	25 kA for 1 second
	Making capacity	62.5 kA
	Mechanical endurance	M1:(1000 operating cycles)
	Electrical endurance	E3, C1

Earth switch	Short-time withstand current	25 kA for 1 S
	Making capacity	62.5 kA
	Mechanical endurance	M0: (1000 operating cycles)
	Electrical endurance	E2

4.7. Circuit Breaker

- The Circuit breaker shall be of fixed type.
- The interruption medium can be either gas insulated or vacuum.
- The circuit breaker shall have three positions; ‘ON’, ‘OFF’, and ‘Earth’ or The circuit breaker shall have two positions; ‘ON’, ‘OFF’, and should be connected with disconnector switch to be able to safe isolation for feeder, and the feeder can be earthed.
- The circuit breaker and earth switch should have two independent manual operating mechanisms to prevent simultaneous closing of the circuit breaker and earth switch.
- The manual switching operation shall be using an operating handle or push buttons. Switching speed shall be independent of the handle speed.
- The circuit breaker shall have anti-pumping and anti-slam protection.
- The opening process of the circuit breaker shall be mechanically by trip button, and electrically by protection relay.
- The closing process shall charge the operating mechanism for the opening process
- The circuit breaker shall have the retrofitting capability on the site for the operating mechanism and associated equipment.
- The circuit breakers should be mechanically and electrically trip free and with provision for manual operation.
- Necessary auxiliary contacts for controlling, signaling& free contacts (2NO-2NC) at least in low voltage compartment and all accessories needed for operation should be provided for each of the circuit breaker and the earth switch.
- The circuit breaker should be fitted with an operation counter.
- The operating handle shall be designed to prevent the opening of the switch-disconnector or the earthing switch after closing.

- An indicator on the front side to present the charging spring status (Charged – Discharged).

Circuit Breaker	Rated Voltage	12 kV
	Rated normal current at 40 C°	200/400/630 A - As required
	Short-time withstand current (I_K)	25 kA for 1 second
	Short circuit breaking capacity (I_{SC})	25 kA
	Making capacity	62.5 kA
	Mechanical endurance	M1: (2000 operating cycles)
	Electrical endurance	E2,S1, C1
	Opening time	Up to 75 ms.
Earth switch	Short-time withstand current	25 kA for 1 S
	Making capacity	62.5 kA
	Mechanical endurance	M0: (1000 operating cycles)
	Electrical endurance	E2

4.8. Instrumental Transformers/Sensors

4.8.1. For metering tarrif Module [M1]

- Three single phase dry type (conventional/ring) current transformers according to EDMS17-400 specification. In case of using ring CT:
  - Highest voltage for equipment Um (R.M.S) 0.72 kV
  - Rated power frequency withstand voltage 3 kV
- The CT shall comply with IEC 61869.

- The current transformers should be interchangeable from lower ratio to higher ratio from the secondary side of the current transformer only.
- The current transformers ratio should by specified by ….EDC on every tender.
- The winding of the current transformers should be made of copper.
- Suitable current transformer shall be a part of RMU compartment along with its complete sizing calculations.
- Three single phase dry type (conventional/screened) voltage transformers according to EDMS17-401.
- The VT shall comply with IEC 61869.
- The voltage transformer shall be (11000/√3/110/√3 V) 50 VA, CL0.5 Voltage factor 1.9 for 8 hrs. & 1.2 continuous feed from bus-bar or outgoing feeder.
- Conventional voltage transformers should be protected by suitable H.R.C fuses on the Primary side. No need for fuses in case of using screened VTs without life parts in the compartment.
- VTs shall be protected by suitable MCBs on the secondary side. Suitable protection system shall be provided to protect the voltage transformer against Ferro-resonance phenomena.
- For conventional CTs and VTs, the leakage path should not be less than 2 cm/kV of the nominal operating voltage.
- Separate box of IP 42 for installing smart energy meter and its connections. The meter dimension (L×W×D) is not less than (293×178×95) mm. Door-open signals for both meter box and CT compartment shall be wired to the terminal block inside the meter box. The front door of the meter box shall be transparent.

4.8.2. <u>For auxiliary supply module [M2] in case of no low voltage feeding</u>

- Single /double pole dry type (conventional/screened) voltage transformers according to EDMS17-401.
- The voltage transformer shall be (11000/√3/suitable value), voltage factor 1.9 for 8 hrs. & 1.2 continuous feed from bus-bar.
- The secondary voltage and burden of the voltage transformer should be design according to the manufacture solution and the RMU configuration.
- The rated continuous output power shall be design regarding to the consumption with safety factor not less than 20%.
- Conventional voltage transformers should be protected by suitable H.R.C fuses on the Primary side. No need for fuses in case of using screened VTs without life parts in the compartment.
- VTs shall be protected by suitable MCBs on the secondary side. Suitable protection system shall be

provided to protect the voltage transformer against Ferro-resonance phenomena.

- For conventional CTs and VTs, the leakage path should not be less than 2 cm/kV of the nominal operating voltage.

4.8.3. For feeders and transformer Modules used for measuring [x] and [Y]

- The current Sensors or Ring core CT
  - Three single phase current sensor and ring core CT should be complying with IEC IEC61869.
  - The current transformers ratio should be according to rated normal current of each module.
  - The winding of the current transformers should be made of copper.
  - The current sensors/ Ring core CT shall has rated and insulation voltages of 0.72 kV/3 kV - 1min.
  - The sensors for protection relay shall provide both measurement and power outputs with class 5P20 for protection and class 1 for measurement. The power supply winding ensures calibrated self-powering of the relay even for currents of just a few Amperes (for [Y1] module).
  - The current sensor/ Ring core CT should be designed to give a thermal protection to the measuring and protection devices during heavy earth faults and should allow for cable fault currents up to 25kA (r.m.s.) and should operate at cable sheath temperature up to 90ºC.
  - Suitable current sensor shall be a part of RMU compartment along with its complete sizing calculations.
  - The current sensors/ Ring core CT should have current injection facility to perform the primary current injection test (preferred).
- Voltage Presence Indicator System (VPIS) or voltage detector system (VDS) should be integrated in all functional modules.
  - VPIS/VDS shall receive the signals through the capacitive sensor installed inside the bushings of RMU which detect the cable side voltage.
  - The indicator shall be flush-mountable.
  - VPIS shall be according to standard IEC 62271- 206.
  - VDS shall be according to standard IEC 61243- 5.
  - VPIS/VDS shall have a low voltage hot phasing facility. The lamps / LCD shall be powered by bushing-type capacitive dividers.
  - VPIS/VDS shall detect the voltage presence /absence and be fitted with a 3 LED/LCD.

- Internal wiring in cable boxes shall be protected with heat resistant tape/tube, against flame temperatures of gas torch during the cable termination.

4.9. Interlocks

- Interlocks between different components of the equipment are provided for reasons of protection and for convenience of operation. Interlocks shall not be damaged by attempted incorrect operations of any associated switching device.
- The interlock shall be provided between electrical and manual operations.
- A mechanical indicator should be provided to show the position of the switches to enable locking at each position separately.
- Manual closing blocking facility for an SF6 circuit breaker in AIS RMU.
- Electrical closing or opening inhibition of LBS or CB in case of low sf6 gas.
- Electrical closing inhibition of LBS or CB in case of cable door is open.
- Arrangements for padlocking should be provided for:
  - Each position of the switches enables locking at each position separately.
  - Electrical Pushbuttons of closing and opening the switches.
  - Mechanical pushbuttons for closing or opening the circuit breaker.
- The switch should be provided with the inter-locks specified in IEC62271-200 but not limited to the following:
  - Operation of the ‘ON/OFF’ mechanism of switch / CB shall be possible only if the earth switch is in the ‘Earth OFF’ position.
  - Operation of the ‘ON / OFF’ mechanism of the earth switch shall be possible only if the mechanism of switch / CB is in the ‘OFF’ position.
  - The cable box cover cannot be opened unless the earth switch is in the “ON” position.
  - LBS or CB cannot be moved “ON” position when the cable box cover is in the open position.
  - Earth switch cannot be closed unless the cable is de-energized (as option according to …EDC requirements)
  - Fuse changing or accessing the fuse chamber cannot be done in any position other than the “Earth” position.

- Additional lock for fuse module:
  Fuse Switch cannot be moved “ON” position when:
  - The fuse access cover is not properly closed
  - Fuse switch in ‘Earth’ position.

4.10. Gas pressure Indicator & Refilling provision

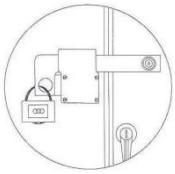
- Temperature independent gas pressure gauge shall be provided. The safe operating zone shall correspond to a temperature range of –10 **°C** to 50 **°C**.
- A refilling non-return inlet valve if provided shall be easily accessible for field refilling.
- The vendor shall give a guarantee for the tank for maximum leakage rate of gas will be lower than 0.1%/ year.
- A SF6 gauge shall be provided for visual indication of SF6 gas pressure inside the switchgear chamber. The SF6 gauge shall be readily visible from the front of the unit without the necessity to remove any covers and be clear marked to indicate the normal gas pressure and low gas pressure on the gauge face.

4.11. Enclosure (Outdoor Use):

- Outdoor RMU shall have a tamperproof and a weatherproof steel enclosure which cover whole body of the RMU and control box.
- The Enclosure should be of electrostatic powder with thickness of 60:80 microns
- The status of the door of the enclosure shall be monitored.
- The enclosure shall provide with lockable doors, door handles, ventilation louvers and lifting hooks.
- The doors of enclosure should be same design of M.V compartment of kiosk.
- The degree of protection shall be IP54.
- All nuts, bolts and washers shall be hot dipped galvanized.
- The enclosure shall have a pocket or provision inside to store the instruction documents and other relevant information.
- The enclosure should be from rolled steel sheets of 2.5 mm thickness before paint at least or with a mechanical impact class not less than IK10 for outdoor use and should support by certificate.
- The roof of enclosure should be galvanized steel, and finished with electrostatic paint.
- The roof of enclosure should have slope (towards to sides) by degree not less than 6°.
- The enclosure should be hot-dip galvanized (HDG) to provide distinct corrosion protection, and finished with electrostatic paint (as option according to ….EDC requirements).
- Air forced ventilation shall be provided with a suitable thermostat.
- The enclosure door should be provided with suitable gaskets, and should have locks with a master

key.

- The enclosure shall be equipped with a base of iron beam with supports to withstand lifting it from the bottom and suitable for the RMU weight. The iron beam shall be painted by two layers one for iron erosion resistant and the 2nd is black.
- Two large galvanized iron bolts (approved closing means) shall be installed, one on the top and the other on the bottom of the left leaf for easy closing and opening the door.
- The doors shall be equipped with two eye-bolts (iron hasp) as shown in the figure. In addition one eye-bolt to be supported by locks.



- The means for non-closing the external doors during maintenance is by mean of a rectangular section attached to the body of the panel with a screw at one end and with a hole on the other end that is fixed with a stent welded to the outer door when it is opened.

4.12. Fault passage Indicator (FPI) for cable feeders:

- The FPI shall be powered by the low voltage feeding (110/220) volts + backup battery for driving the fault indication led for 8 hours with life not less than 15 years.
- The FPI is required for each feeder, mainly indicate the following features:
  - Directional Phase to phase fault.
  - Directional Phase to earth fault.
- The FPI fault shall be feed from the VPIS/VDS and current sensors or ring core CT.
- The FPI should be designed to be self-operated.
- The FPI device should sense the direction passage of the fault current through the cable.
- FPI should be equipped with self-supervision facility.
- FPI shall integrate with external outdoor fault lamp indication LED type (fixed on visible place) should emit a blinking red light with IP54 according to IEC 529, lamp auto reset at healthy condition. Connection of this outdoor unit is not compulsory.
- The FPI shall include the following features:
  - Compatible with RTU communication protocol, support Modbus TCP or Modbus RTU or 60870-101/104 or IEC61850 communication protocols.

- Support enough NO/NC output contacts operated with fault condition for covering all required signals in case of separate module.
- Protection of enclose IP40 or above.

- FPI shall have a latched output when the current exceeds the threshold value for overcurrent and the earth fault.
- The reset to the healthy condition should include: (Fault current is cleared, adjustment time delay, software, sense current due to the cable re-energize, and sense the voltage due to the cable re-energize).
- FPI shall have a time-tagged events
- Easily replaced and maintained.
- Compact size.
- Withstand a temperature range of -30 up to +70°.
- Not responsive to mechanical shocks.
- Protected against sun, radiation, humidity and dust.
- It should be provided with an indication for transient and permanent faults.
- Measuring continuous current and voltage for each phase.
- Phase to earth fault function:
  - Indicator should support adjustable setting range (10-180 A) primary current with suitable step.
  - Indicator should support fast act time response at fault condition (0.06 Sec. or less).
- Phase to phase fault function
  - Indicator should support wide adjustable setting range (225-700) primary current with suitable step.
  - Indicator should support fast act time response at fault condition (0.06 Sec. or less).

4.13. Capacitor divider and phase comparator

- Every load break switch or circuit breaker cell should be equipped with three capacitor dividers connected to the voltage presence indicator system monitored by LEDs or LCD to indicate the voltage presence on the cable.
- There should be a facility to check the phases concordances with the use of external device. This external device shall be provided with the RMU.

4.14. Protection Relay for [Y1] module

The protection relay shall be three phases combined non-directional (over current + earth fault & short circuit) digital protective relay and timer in one unit connected to three current transformers/sensors of the protected object and suitable for resistance earthed neutral system, in solidly grounded system the residual over current protection can be used on feeder of any length and fulfilling the following requirements and specifications:

4.14.1. Technical Specification

Protective relay should select based on the following specifications:

- The protection relay is based on a multiprocessor environment.
- The modern technology should be applied in both hardware and software solution.
- The relay must be designed for protection against (O.C. & E.F & S.C & Thermal) includes the following:
- Reset factors > 95%
- Operation temp. From -5^{o}C to +60^{o}C
- Humidity > 90% non-condensation.
- It should be able to operate without intended delay.
- Definite and inverse time characteristics according to IEC standards.
- Two programmable LEDs (besides LEDs of ready of protection, trip indication and internal fault indication) with suitable reset pushbutton and can be automatically rested and include one LED for each fault type and monitoring.
- Self-monitoring and blocking for internal faults with alarm contact and led indication.
- Support a digital screen for current measurements.
- The relay shall have external trip capability to trip the CB if Buckloz relay trip in case of oil transformer or temperature high for Dry transformer by mean of digital input.
- The three phases overcurrent unit and the earth fault measure the phase current and the neutral current of the protected object.
- The relay should be flush mounted.
- The relay must be digital type and combatable with RTU communication protocol which supports Modbus or IEC-61850 communication protocol.
- Output contacts (Tripping contacts).
    - Rated voltage: related to the auxiliary supply voltage with ripple content (3-4) %.

- Continuous carrying capacity 5 ADC.
- Making and carrying current capacity for 0.5 sec > 20 A.
- Make and carry for 3.0 sec > 10 A
- Free contacts at least (1 N.O for O.C & 1 N.O for E.F) besides the watch dog contact.

- The actuator shall be a low power tripping coil specifically designed to operate with the sensors and the processing unit with minimum energy.
- Three-phase thermal protection.
- The relay must have the inrush current blocking based on the second order harmonic percentage which can be used in all protection stages, without using multiplayer
- Support a digital screen for current measurements, parameter, setting and events.
- All parameters and events can be set or read by P.C and manually by key pad
- Smaller dimensions preferred
- Tender must supply with offer detailed instruction and catalogue
- The relay must include event recorder and should be read by screen or software.
- Original software, firmware, plug connections to (PC and / or laptop) for all protection relays and test plugs should be provided by the contractor.
- Continuous self-supervision and diagnosis of electronics and software
- User-selectable password protection for HMI
- Display of primary/secondary current values
- Housing degree of protection IP 54 according to IEC 60529.
- The output contact functions freely configurable for desired operation.
- The relay should have at least two setting tables.
- Not responsive to mechanical shocks.
- Protected against sun, radiation, humidity and dust.
- RMU manufacturer to provide suitable supplying for protective relay must have a dual power:
  - Self-powered: energized by the CT's
  - External supply: energized by uninterrupted power supply.
- Complied with MV relay standard IEC-60255.
- The protection relay shall be approved form the protection central sector of EEHC.

4.14.2. <u>Non-volatile memory for the following:</u>

- The digital protective relay should be equipped with a nonvolatile memory for preserving important data during auxiliary supply breaks. The memory does not need batteries, and a lifelong service is guaranteed, and following data is stored:

• Date and Time.
• Setting values
• Recorded last five fault data.

4.14.3. The real-time clock

- The relay must be supported by a real-time clock (RTC) which used for time stamping of events. It is also running during auxiliary power breaks. When the supply is RE-established, the relay sets the right time and new events are stamped accordingly.

4.14.4. The relay must include the following protection:

- I > Three-phase low-set over current stage with definite–time and inverse definite minimum time characteristic (IDMT)
- I >> Three-phase high-set over current stage with the instantaneous or definite time characteristic.
- Io > low-set non-directional earth –fault stage with definite-time or inverse definite minimum time characteristic (IDMT).
- Io >> High-set non-directional earth-fault stage with instantaneous or definite –time characteristic.
- **Setting values and ranges:**
  - Current stages (over current)
    • Low set over current I > (0.1 - 5) In with steps < 0.05 In.
    • High set over current I >> (0.2 - 20) In with steps < 0.05 In
  - Operating time ranges (over current)
    • Operate time in DT mode: (0.05 - 3) sec with step < 0.01 sec
  - Current stages (earth fault)
    • Low set earth fault Io>: (0.06 – 1) In with steps < 0.01 In.
    • High set earth fault Io>>: (0.2 - 10) In with steps < 0.01 In.
    • Sensitive earth fault: (0.005 – 0.5) In (as option by a core balance CT)
  - Operating time ranges (earth fault)
    • Operate time in DT mode: (0.05 - 3) sec with step < 0.01 sec.
    • Sensitive earth fault: (0 – 3) sec. (as option by a core balance CT)

4.14.5. Standard tests

- **Insulation tests**
  - Dielectric tests: according to the (IEC 60255/5 &60225/5 or equivalent) tests voltage 2 KV 50 Hz, 60 sec.
  - Impulse voltage test according to the (IEC 60255/5 & 60225/5 or equivalent) Tests voltage 5 kV, unipolar impulses, waveform 1.2/50μs.
  - Insulation resistance measurements according to the IEC60255/5.
- **High frequency interference withstands:**
  - According to class III of IEC 60225
- **Over load**
  - Current circuit temporary ≥ 25 kA primary for 1.0 sec.
- **Mechanical tests**
  - Vibration test (sinusoidal) according to the IEC 60255.
  - Shock and bump test according to the IEC 60255.

4.14.6. Diagnostic and Supervision

- Supervision functions for energizing current input circuit.
- Self-test diagnostic**.**

4.14.7. Measurement

- Display primary current values (IR-IS-IT-IN).
- Transient disturbance Events.

4.14.8. Communications:

The relay should support local and remote communication, local communication with P.C or laptop and suitable remote communication to be connected with the RTU.

4.14.9. Associated current transformer

Suitable current transformer for protective relay shall be a part of RMU compartment along with its complete sizing calculations. It shall be for measurement and powering purposes.

4.15. For GIS

4.15.1. General

- Protection degree IP:
  L.V mechanism compartment / cable compartment: IP3X/IP2X respectively. It is necessary to close and cover all openings with the panel front well so as not to allow any dust penetration into the panel or the mechanism.
- All load break switches should be accommodated in one tank and may be-accommodated every load break switch to be on a separate tank (as option according to ….EDC requirement).
- The gas pressure indication for the tank should be through two stages (Low for alarming– insufficient for operation blocking) or one stage in case of completely sealed tank.
- The envelope should be permanently sealed and filled with SF_6 gas at suitable pressure.

4.15.2. Terminal bushing/Cable Box

- Terminal bushing in the RMU shall be suitable for cable termination inside cable box suitable for acceptance single/three core AL/CU XLPE insulated cables up to 400/630 mm2.
- Each cable box shall have a bottom plate and a cable clamp. Bottom plate shall be in two halves with cable entry hole of suitable diameter. Cable clamp shall be detachable semi-circular halves suitable to hold the cable inside the cable box without cable glands. Suitable rubber fitted to each cable entry hole.
- Terminal bushings for RMU shall be interface type C with M16 bolted contact for terminating cables with the use of L elbow type or (T elbow type as option according …EDC requirements).
- Vertical distance from the top of cable clamp to centerline of cable bushings shall be suitable for all type of terminations
- Removing and installing of cable box cover shall be with minimum number of bolts.

4.15.3. Earthing

Aground bar of not less than 125 mm2 copper shall be provided bolts to the frame. It shall be located so as to facilitate earthing of cable sheaths, elbows and earthing devices

4.16. For AIS

- The gas pressure indication for the SF6 (LBS and CB) should be through two stages (Low for alarming– insufficient for operation blocking) or one stage in case of completely sealed tank.

- Heater of 100-watt, 220v AC with a hygrostat and a M.C.B per each module in cable compartement.
- Additional 200 watt, 220v AC heater shall be installed in the bus bar compartment with its associated MCB and hygrostat.
- Protection degree IP3X.
- The creepage distance of the resin insulator should be not less than 2 cm/KV.
- Main Bus Bar:
  - It should be insulated B.B system and made of high grade of electrolytic copper at least 630A for all RMU panel should not be less than 400 mm^2.
  - The temperature rise should be according to IEC 60271-103.
  - All main bus bars should be insulated by red anti-track heat shrinkable tubes and the connection points should be covered with a suitable insulated cover.
  - The bus-bar compartments should be placed at the upper part of the switchboard and fitted with using dielectric supports.
  - The entire bus and structure should be constructed to withstand the short circuit effects due to the rated short circuit current of 25 kA for 1 Sec at least.
  - The Bus bar connections should be anti- oxide greased.
  - Main B.B should be extendable and securely mechanically bonded to each unit.
- Earth Bus Bar:
  - An earth copper bar at the bottom of the switchboard extending the entire length of each distribution panel should be provided with a cross section area to withstand the rated short circuit current of the system the bus should be extendable and securely mechanically bonded to each unit.
  - Copper earthing bar 125 mm2, each earthing switch should be connected to the earthing bar through copper braid of 25mm2

5. Low Voltage cabinet

- It should be stand on the top of the RMU with suitable clearance and shall be accessible from the front.
- It shall comply with IEC 529, with an index of protection IP 42.
- The enclosure shall provide reserved space for the RTU hardware, battery / PS, modem MCBs, terminal blocks and auxiliary relays.
- The enclosure should be Pad lockable and fabricated using 2 mm thick of stainless steel.
- The low voltage panel door shall be provided with key lock (master key)

- Temperature monitoring and accurate controlled forced air cooling
- Operating temperature range from 0C° to + 70 C°.
- All wiring in the RMU shall be labeled directional from / to.
- The following signals shall be wired to the terminal block in the low voltage cabinet.

Per RMU	SF6 indication (low gas and/or insufficient)for one tank or for each cell in case of separate tanks
	Energy tariff meter door open
	CT tariff meter compartment door open
Per [X]	Phase to phase fault
	Earth fault
	Cable door open
Per [Y1]	CB spring discharged for CB
	Protection relay OC Trip
	Protection relay EF Trip
	Protection relay Faulty (IRF)
	Cable door open
Per [Y2]	Any fuse blown
	Fuse rack out for GIS if available
	Cable door open
Per RMU	LBS ON/OFF
	CB ON/OFF
	ES ON/OFF
For [X] & [Y]	Close command
	Open command

6. Testing and inspection:

6.1. Type Test:

– All equipment shall be successfully type tested at EEHC approved laboratory in accordance to the

latest relevant standard for the following:

a) High-voltage switches as per IEC 62271-102/103
b) High-voltages switchgear and controlgear as per IEC 62271-200
c) High-voltage switch fuse as per IEC 62271-105
d) Circuit breaker as per IEC 62271-100
e) Degree of protection as per IEC 60529.

Note: see appendix A for the detailed type tests.

6.2. Routine Test:

Routine tests of the RMU should be carried out according to latest relevant IEC standards by the manufacturer; a representative of Distribution Company will attend these tests before acceptance.
The…...EDC have the right to add any test during delivery to check the quality of the product.

6.2.1. High-Voltage switches as per IEC62271-102/103
6.2.2. High-Voltage switch fuse as per IEC62271-105
6.2.3. High-Voltages switchgear and controlgear as per IEC62271-200
6.2.4. Circuit breaker as per IEC62271-100
6.2.5. Measurement unit as per IEC81869-2 and 3

Each and frame equipped with protection relay a primary current injection test shall be conducted

…EDC reserves the right to visit the factory during manufacture of any or all items covered by this specification, for inspection of material or witness of tests.

Accordingly, the manufacturer shall give …EDC testing schedule.

Panel's Type:	Panel's Name	
DESCRIPTION OF TESTS: Pass(P) , Fail (F) , Un-completed (U) , Not available (NA)		
A	Electrical and Mechanical characteristics of RMU	**Evaluation**
1	Visual inspection tests: ▪ All integrated component is compliant with the drawing ▪ No physical damage ▪ Check the nameplates and general labeling form/to. ▪ Checking SF6 indicator. ▪ Inspect MV cable compartment, earth bar, cable support, cable	

	clamp	
2	Dielectric test MV and LV	
3	Voltage drops on Earthing circuit and main circuit	
4	▪ Manual operating tests MV breaker / switch disconnector and mechanical interlock. ▪ Electrical operating tests for circuit breaker/ switch disconnector ▪ Circuit breaker contact resistance and timing test.	
5	Interlocks ▪ The purpose of the test is to check that it is not possible to operate the functional unit when there is an interlock	
B	Fault passage Indicator	
	The purpose of the test is to check the function of the FPI: ▪ Directional Phase to phase fault. ▪ Directional Phase to earth fault.	
C	Protection Relay	
	The purpose of the test is to check the trip of the transformer breaker in case of trip condition: ▪ Phase fault ▪ Earth fault	

7. Training:

….EDC reserves its right to claim a priceless training of its representatives on the vendor's factory, site, and lab.

The training should include and not limited to the following:

1. Installation.
2. Testing & Commissioning.
3. Troubleshooting.
4. Operating and Maintenance

8. After sale Service:

The tenderer should have a licensed service center in Egypt covers all its deliverables.

….EDC reserves its right to claim a free after sale service all over the warranty period guaranteed by the tenderer that covers all its deliverables, after sale services should include and not limited to the following:

1. Technical support.
2. Maintenance.
3. Original Spare parts.
4. Submittals.

- All the services, spare parts, materials and accessories will be needed during the after-sale maintenance should be guaranteed by the tenderer immediately and wherever required (Warehouse – Site – Lab. ….etc.)

9. Warrantee

- The supplier guarantees the RMU and RTU against all defects arising out of faulty design or workmanship, or of defective material for period of (5) years from date of delivery.
- Warranty period for gas tightness (seal pressure system) shall conform to the relevant IEC and the contractor shall assume full responsibility for no gas leakage during the service life.
- The good quality and manufacturing of the materials should be guaranteed.
- Any parts which on account of poor quality of the materials, manufacturing defects or poor assembly, should be replaced or repaired in the shortest time possible and free of charge.

10.Marking

10.1. The following data should be engraved or laser printed on an aluminum/stainless steel nameplate riveted on the Ring main unit and Enclosure and located in a visible and legible place when the switchboard is installed showing the following information:

- Manufacturer’s name
- Type/Model
- Serial Number and year of Manufacturing
- Distribution company name
- order number
- indoor or outdoor application
- Rated voltage and rated insulation level

- Rated frequency
- N1 no. LBS + N2 no. CB/F and the type (GIS/AIS)
- Rated and duration of short-circuits current (KA/sec)
- Making current KA
- degree of protection
- Gross Weight(KG)
- IEC standards
- IAC type and (KA/time).

10.2. The following data should be cleared per cell (Switch disconnector, Switch fuse disconnector/CB) and located in a visible and legible place showing the following information, Entries on the plate should be indelibly marked be etching or engraving:

- Type/Model
- Rated voltage and rated insulation level
- IEC standards
- Rated current (A) and Rated voltage (V).
- Rated and duration of short-circuits current (KA/sec)
- Making current KA
- Electrical and mechanical endurance
- Rated frequency
- Serial Number and year of Manufacturing

11.SUBMITTALS

11.1. Vendor shall provide the following with the quotation:

- Clause by clause compliance with the specification.
- All necessary drawings including the scheme drawing of the RMU, dimensions, single line diagram of (control circuit, tripping circuit, closing circuit, voltage supply circuit, VT and CT connections, Alarms, communication……etc.)
- Technical catalogues containing the technical data for all offered components of the unit should be submitted.
- Installation and maintenance instructions.
- Copy of type test report.
- A valid approved letter must be submitted from the Egyptian Electricity Holding Company
- A comprehensive list of manufacturer's recommended spare parts. The quantities

offered should be adequate for the initial 5 years of operation. Firm price and delivery period shall be quoted for each item and ….EDC has the right to request the spare part list or not

11.2. Vendor shall provide the following after signing of purchase order:

- Details of manufacturing and testing schedules
- Routine test reports (including tightness test)

11.3. Vendor shall provide the following with delivering:

- Operation (user) manual.
- Handles, Master Keys, Locks….. for operation and locking.
- External device to check the phases concordances.
- Testing rods for HIPOT (High Potential) test.
- Testing rods for current injection test.
- Testing device for protection relay if existing of a dedicated testing device.

12.OPTION LIST:

The following table should be filled/attached by …EDC during tendering.

NO.	Option	Needed	Not Needed
1	Ambient temperature: 50°C		
2	Outdoor RMU		
3	The RMU may be extendable		
4	The internal arc class of the RMU should be provided with downward/upward ventilation		
5	A suitable base for RMU shall be provided		
6	The enclosure should be hot-dip galvanized (HDG)		
7	Sensitive earth fault for protection relay		
8	Every load break switch to be on a separate tank		
9	Interlock (cannot close the earth switch if the cable energized)		
10	Cable compartment is suited for (T) elbow type connection		
11	Circuit breaker rated current (200-400-630)A	.....	
12	[X], [Y1 or Y2], and [M1 or M2] should be defined according to ….EDC requirements: NO. of [X]: , NO. of [Y…]: ,NO. of [M…]: H.R.F capacity: ,C.T. Ratio:		

13. TECHNICAL DATA SCHEDULE

The guarantee schedules should be submitted and the tenderer should fill in the attached guarantee tables. ….EDC reserves the right to reject any tender not accompanied with clear and complete guarantee tables.

GUARANTEE TABLES

No	Item	Vendor Spcs.
	General	
1	Rated (Maximum operating) voltage	…….KV
2	Nominal operating (Service) voltage	…….KV
3	Power frequency R.M.S. withstand voltage (1 min)	…….KV
4	Impulse withstand voltage (1.2/50) µs peak	…….KV
5	Rated frequency	…….HZ
6	Color	…….
7	Auxiliary voltage	…….V
8	IP Class (Gas Tank)	…….
9	Copper purity	……%
10	Copper Conductivity	……MS/m
	Environmental conditions	
1	Ambient temperature	……°C
2	Average relative humidity	……°C
3	Maximum altitude	……m
Design and construction requirements		
	Indoor RMU	
1	RMU Type	……
2	RMU configuration	……

3	Thickness of sheet steel/IK protection	……mm
4	Thickness of electrostatic paints	…… microns
5	Dimensions: Width *Depth *Height	..…mm*…...mm*…..mm
6	The internal arc: Class: KA: Time: Outlet:	 …… ……KA ……sec ……
7	Load Break Switch:	
8	IEC Standards	
	Switch disconnector	
1	Rated Voltage	……KV
2	Rated normal current at 40&45&50 C°	……/……/…… A
3	Short-time withstand current	……KA
4	Making capacity	……KA
5	Mechanical endurance	……
6	Electrical endurance	……
	Earth Switch for Switch disconnector	
1	Short-time withstand current	……KA
2	Making capacity	……KA
3	Mechanical endurance	……
4	Electrical endurance	……
	Switch fuse disconnector	
1	Rated Voltage	……KV
2	Rated normal current at 40&45&50 C°	……/……/…… A

3	Short-time withstand current	……KA
4	Making capacity	……KA
5	Mechanical endurance	……
6	Electrical endurance	……
Earth Switch for Switch Fuse disconnector		
1	Short-time withstand current	……KA
2	Making capacity	……KA
3	Mechanical endurance	……
4	Electrical endurance	……
Circuit breaker		
1	Type/Model	……/……
2	Interruption medium	……
3	Rated Voltage	……KV
4	Rated normal current at 40&45&50 C°	……/……/…… A
5	Short-time withstand current	……KA
6	Making capacity	……KA
7	Mechanical endurance	……
8	Electrical endurance	……
9	Duty cycle	……
10	Opening time	……ms
11	Operating mechanism	……
Earth Switch for Circuit breaker		
1	Short-time withstand current	……KA
2	Making capacity	……KA
3	Mechanical endurance	……

4	Electrical endurance	……
CT		
1	Product type	……
2	Highest voltage for equipment Um (R.M.S)	……KV
3	Rated primary service voltage	……KV
4	Rated frequency	……HZ
5	Rated primary current	……A
6	Rated secondary current	……A
7	Current continuous factor	……
8	Rated short time "thermal" withstand current (RMS) For 1 sec KA)	……KA
9	Accuracy class	……
10	Rated Burden	……VA
11	Creepage distance	……cm/kV
12	Class of insulation	……
VT		
1	Product type	……
2	Highest voltage for equipment Um (r.m.s)	……KV
3	Rated primary service voltage	……KV
4	Rated frequency	……HZ
5	Rated primary voltage	……V
6	Rated secondary voltage	……V

7	Voltage factor	……
8	Rated impulse withstand voltage for primary windings	……KV
9	Short duration withstand (r.m.s) voltage for primary windings (1min)	……KV
10	Rated power frequency short duration withstand for secondary winding for 1 minute	……KV
11	Accuracy class	……
12	Rated Burden	……VA
13	Creepage distance	……cm/kV
14	Class of insulation	……
Current Sensors or Ring core CT		
1	Rated current	……A
2	Rated Burden	……VA
3	Rated short time "thermal" withstand current (RMS) For 3 sec I_{th}	……KA
4	Accuracy class	……
5	Accuracy limit factor	……
Voltage Presence Indicator System (VPIS)/(VDS)		
1	Product type	……
2	IEC standards	……
3	It shall have a low voltage hot phasing facility. The lamps / LCD shall be powered by bushing-type capacitive dividers.	Yes/no
4	It shall detect the voltage presence /absence and be fitted with a 3 LED/LCD.	Yes/no

5	It shall deliver the measured signal to the RTU.	Yes/no
	Interlocks	
1	Matching all requirements	Yes/no
	Enclosure Outdoor Use:	
1	Thickness of sheet steel/IK protection	……mm
2	Thickness of electrostatic paints	……microns
3	Dimensions: Width *Depth *Height	……mm*……mm*……mm
4	IP protection	……
	Fault passage Indicator (FPI)	
1	Integrated/separate	…….
2	Feeding source	…….
3	IP	…….
4	Matching all requirements	Yes/no
	Capacitor divider and phase comparator	
1	Every load break switch or circuit breaker cell should be equipped with three capacitor dividers connected to the voltage presence indicator system monitored by LEDs or LCD to indicate the voltage presence on the cable.	Yes/no
2	There should be a facility to check the phases concordances with the use of external device. This external device shall be provided with the RMU.	Yes/no
	GIS	
1	Model	…….
2	IP protection for Cable Box and Mechanism	…….
3	C.S.A of earthing bar	…….
4	Interface type of Terminal bushings and size of bolt	…….
5	Stages No. for the SF6 pressure indication for the tank	…….

6	Rated short circuit current for 1 Sec	…….
AIS		
1	Model	…….
2	IP protection	…….
3	C.S.A of Bus bar	…….
4	C.S.A of earthing bar	…….
5	Creepadge distance	…….cm/kV
6	Heater of 100-watt, 220v AC with a hygrostat and a M.C.B per each module.	Yes/no
7	Additional 200 watt, 220v AC heater shall be installed in the bus bar compartment with its associated MCB and hygrostat.	Yes/no
8	Rated short circuit current for 1 Sec	
Protection Relay for [Y1] module		
1	Maker 's name	…….
2	Country of manufacture	…….
3	Type and designation	…….
4	Standard specification with which relay complies	…….
5	Relays characteristics	…….
6	Range of relay setting	I……(A) / T……(Sec)
7	Current rating of relay coil	…….A
8	Voltage rating of relay coil	……. V
9	Auxiliary supply rang	…….DC (V)
10	Relay order number	…….
11	Dual power supply	Yes / No

12	Low power trip coil	Yes / No
13	Standard reconfiguration functionality	…….
14	External trip function	Yes / No
15	Communication protocol / port	……./…….
16	The relay should meet the latest revision of IEC publication 60255 standard	Yes / No

We guarantee the data given above for the equipment offered.

Signature: ……

Date: ……..…….

APPENDIX A

RMU (AIS / GIS) type tests

1. **High-Voltage switches as per IEC62271-103/102 (LBS)**

2. Dielectric tests.
3. Temperature-rise tests.
4. Measurement of the resistance circuit.
5. Short-time withstand current and peak withstand current tests.
6. Tightness tests.
7. Making and breaking test.
8. Mechanical test.

2. **High-Voltage switch fuse as per IEC62271-105 (fuse-LBS):**

1. Dielectric tests
2. Temperature-rise tests.
3. Measurement of the resistance of circuit.
4. Tightness tests.
5. Tests to prove the combination to make and break the specified currents.
6. Mechanical operation test
7. Mechanical shock test on fuse.
8. Thermal test with long pre-arcing time of fuse.
9. Short-time withstand current and peak withstand current tests.

In case of the switch fuse disconnector has the same design of switch disconnector, Type tests no. 5, 7 and 8 shall be only applied.

3. **Circuit breaker as per IEC62271-100:**

1. Dielectric tests
2. Measurement of the resistance of the main circuit
3. Temperature-rise tests
4. Short-time withstand current and peak withstand current tests
5. Mechanical operation test at ambient temperature (class M1)
6. Short-circuit current making and breaking tests
7. Tightness test
8. X-ray radiation test

9. Electrical endurance tests (only for Ur ≤ 52kV)
10. Capacitive current switching tests.

4. <u>High-Voltages switchgear and control gear as per IEC62271-200:</u>

1. Rated Insulation level.
2. Measurement of the resistance of circuits
3. Rated contionus current and measurement of the resistance of circuits
4. Capability of the main and earthing circuits to be subjected to the rated peak and rated Short-time withstand currents
5. Making and breaking capacity of the included switching device. <u>See Note 1</u>
6. Mechanical operation of the included switching devices and removable parts. <u>See Note 2</u>
7. IP protection code.
8. IK Protection degree
9. Pressure withstand of gas - filled compartments.
10. Tightness of gas – or liquid- filled compartments. <u>See Note 3</u>
11. IAC classification
12. Electromagnetic compatibility (EMC).<u>See Note 4</u>

<u>Note 1 according to IEC 62271-200:</u>

Switching devices forming part of the main circuit and earthing switches of assemblies shall be tested to verify their rated making and breaking capacities according to the relevant standards and under the proper conditions of installation and use. That is, they shall be tested as normally installed in the assembly with all associated components that may influence the performance, such as connections, supports, provisions for venting. These tests are not necessary if making and breaking tests have been performed on the switching devices installed in assemblie with identical or more onerous conditions.

<u>Note 2 according to IEC 62271-200:</u>

All switching devices not previously tested as mounted in the assembly, shall be operated 50 times C-O, mounted in the assembly. Test conditions and criteria to pass the test are identical to the ones defined on each corresponding switching device standard for mechanical tests.

Note 3 according to IEC 62271-1:

Where possible, the tests should be performed on a complete system. If this is not practical, the test may be performed on parts, components or subassemblies.

Note 4 according to IEC 62271-1:

Auxiliary and control circuits of switchgear and controlgear shall be subjected to electromagnetic emission/immunity tests if they included electronic equipment or components in other cases no test are required

Note 5 according to IEC 62271-200:

The type test for [M] module shall be according to IEC 62271-200 and shall include tests number

1. Rated Insulation level.
2. Measurement of the resistance of circuits
3. Rated contionus current and measurement of the resistance of circuits
4. Capability of the main and earthing circuits to be subjected to the rated peak and rated Short-time withstand currents
5. IP protection code.
6. IK Protection degree
7. Tightness of gas – or liquid- filled compartments.
8. IAC classification
9. Electromagnetic compatibility (EMC).