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TECHNICAL SPECIFICATIONS

AND

GUARANTEED TECHNICAL PARTICULARS

FOR

11kV AND 33kV 3-WAY, OUTDOOR TYPE

RING MAIN UNIT

Prepared by	Checked by	Checked by	Checked by	Approved by
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Specification/GTP No: **CE/P&P/SPEC/2023/11KV & 33KV RMU/030**		Date of Issue: **07/01/2023**	Rev 0	

This Tender Specification and Guaranteed Technical Particulars are for tendering purpose only and may be subjected to the modification by the purchaser as per actual field requirement. Contractor/Supplier to submit the Guaranteed Technical Particulars (GTP) and Drawings, after the award of the Contract, for approval of the Purchaser.

In case any discrepancy is noticed in this Specification/GTP, please report to Chief Engineer P&P, KPDCL.

CLIMATIC AND ISOCERAUNIC CONDITIONS (CIC)

1.	The climatic and Isoceraunic conditions at the site of work are approximately given asunder:	
	Description	Kashmir
i)	Max. temp of air in shade	30.6^0C
ii)	Min. temp of air in shade	-20^0C
iii)	Max. temp of air in sun	45^0C
iv)	Height above sea level (App.)	1600 Mtrs.
v)	Max. relative humidity	90%
vi)	Min. relative humidity	15%
vii)	Average no. of thunderstorm days per year	54
viii)	Average rainfall	80 cm
ix)	Wind Zone	WZ –3
x)	Average number of rainy days per year	106
xi)	Seismic Zone	SZ–5
xii)	Area of installation	Heavy Snow Zone
2.	**Communication and Transport:** The nearest railway station is Udhampur on the broad gauge line and is connected to the Divisional Stores by a metal road. The equipment is required to pass en-route through various tunnels on NH-44 (Nandni, Nashri and Jawahar Tunnel). The weight and maximum dimensions of the packages suitable for transportation through tunnel route are as follows:- **1.** Length=7.0 m **2.** Width=3.0 m **3.** Height=4.55 m **4.** Weight=40 MT The supplier shall get the permissible weight and dimensions confirmed from the Highway Authorities before proceeding with the manufacture of the equipment. It will be the responsibility of the supplier to ensure timely and proper delivery of the equipment on door delivery basis, at Srinagar, through road transport. The supplier shall also ensure that the weights and dimension of the packages which are suitable to be carried by road transport up to Srinagar.	
3.	**Additional conditions**	
i	Permitted Noise Level	45 dB
ii	Induced Electromagnetic disturbance	1.6 kV
iii	Pollution class/Creepage distance	III/ 25mm/kV
iv	Isoceraunic Level (days/year)	50
v	Condensation	Occasional

A). TECHNICAL SPECIFICATION OF 11KV, 3-WAY,OUTDOOR TYPE,SCADA COMPATABLE RING MAIN UNIT

1 SCOPE OF SUPPLY

This specification covers design, manufacture, assembly, stage inspection, testing before supply of SF6 gas filled 11 kV,630 Amps, outdoor, SCADA compatible Motorized Ring Main Unit with 630 Amps Vacuum Circuit Breaker.

It is not the intent to specify completely herein all details of the design and construction of equipment. However, the equipment shall conform in all respects to high standards of engineering, design and workmanship and shall be capable of performing in continuous commercial operation up to the Bidder's guarantee in a manner acceptable to the Purchaser, who will interpret the meanings of drawings and specification and shall have the power to reject any work or material which, in his judgment, is not in accordance therewith.

The equipment offered shall be complete with all components necessary for their effective and trouble free operation. Such components shall be deemed to be within the scope of Bidder's supply irrespective of whether those are specifically brought out in this specification or not.

The RMU should be fixed type SF-6 insulated with two Load Break Switches and vacuum circuit breakers with O/C & E/F relay for the protection of the transformer. It should be maintenance free equipment, having stainless steel robotically welded enclosure.

The design of the switchgear should be exclusive and specific responsibility of supplier and should be comply with current good engineering practice, the relevant codes and recommendation, the project specific requirements.

2 STANDARDS

The RING MAIN UNIT (RMU) should be designed, manufactured and tested according to the latest version of:

IEC 60694 Common specifications for high-voltage switchgear and control gear standards.
IEC 62271-200 : A.C metal-enclosed switchgear and control gear for rated voltages above 1KV and up to and including 72kV and the IEC Codes herein referred.
IEC 62271-102: Alternating current disconnectors (isolators) and earthing switches
IEC 60529 : Classification of degrees of protection provided by enclosures
IEC 60265 High-voltage switches-Part 1: Switches for rated voltages above 1kV and less than 52kV
IEC 60056 : Circuit breakers
IEC 62271-105 High-voltage alternating current switch-fuse combinations IEC 60185 Current transformers
IEC 60186 Voltage transformers
IEC 60255 Electrical relays
Any other codes recognized in the country of origin of equipment might be considered provided that they fully comply with IEC standards.

The design of the switchgear should be based on safety to personnel and equipment during operation and maintenance, reliability of service, ease of maintenance, mechanical protection of equipment, interchangeability of equipment and ready addition of future loads.

3.0 11 KV SF6 Insulated Compact Ring Main Unit (RMU)

11KV SF6 Outdoor, Extensible, Ring Main Unit (RMU), should comprise of 630A Load break switches and 630 A Vacuum "T" OFF Circuit Breaker with (3 O/C & 1 E/F) Relays.

The Load break switches and VCB shall be possible to configure the switchboards as per the site requirements. Maximum four functional units (cable switch/ VCB) can be accommodated in one single tank so as to make it more compact and reliable.

(A) Load break switch (630A)

Load break switch should have the following

1.Manually operated 11kV, 630A Load Break switch shall be a two-positioning Load Break puffer switch using SF-6 gas as an arc quenching medium and separate Earthing Switch with making capacity.

2."Live Cable" LED Indicators through capacitor voltage dividers mounted on the bushings.

3 Mechanical ON/OFF/EARTH Indication.

4.Anti-reflex operating handle

5. Cable Testing facility inside cable boxes without disconnecting the Cable terminations

6. Cable boxes suitable for 1 X 3C x 300 sq mm XLPE Cable with right angle Cable Termination Protectors.

7. Cable boxes should be Arc Proof and interlocked with respective Earthing Switches.

For safety of operator it should not be possible to open the cable box unless the earth Switch is ON

(B) Circuit Breaker (630A)

Circuit Breaker should have the following:

1 Manually operated 630 Amp Vacuum circuit breaker with auto reclosing duty and rated operating sequence of 0 – 0.3s - CO - 15s CO.

2.Two position operating mechanism for series downstream disconnector and earth switch.

3.Mechanical ON/OFF/EARTH/SPRING CHAGRE Indication

4.Operation Counter.

5.Integrated operating handle fixed with breaker

6."Live Cable" LED Indicators through Capacitor Voltage Dividers mounted on the bushings.

7.3O/C + 1E/F self powered relay with Low and High set for Over current and Earth Fault with ring core CT on cables.

8.Cable boxes suitable for 1 X 3C x 300 sq mm XLPE Cable with right angle Cable Termination protectors

9.Cable boxes should be Arc Proof and interlocked with respective Earthing Switches. For safety of operator it should not be possible to open the cable box unless the earth Switch is ON.

4.0 GENERAL TECHNICAL REQUIREMENTS

4.1 DESIGN PARAMETERS

Highest System Voltage	kV	12 kV
Nominal System Voltage	kV	11 kV
Power Frequency Withstand Voltage - Across Disconnector	kV	28
Impulse Withstand Voltage - Across Disconnector	kVp	75
Rated Frequency	Hz	50
Rated Current Bus bars	A	630
Rated Current (Cable Switch)	A	630
Rated Current (Vacuum Circuit Breaker)	A	630
Breaking Capacities:		
Active Load	A	630
Closed Loop (Cable Switch)	A	630
Off Load Cable Charging (Cable switch)	A	135
Short Circuit Breaking Current (Vacuum Circuit Breaker)	kA	20
Rated Making Capacity	kAp	50
Rated Short Time Current	kA	25kA/3-sec

4.1.1 Ring Main Unit, Electrical data (11 kV)

4.1.2 General data, enclosure and dimensions

Standard to which Switchgear complies	**IEC**
Type of Ring Main Unit	Metal Enclosed, Panel type, Compact Module.
Number of phases	3
Whether RMU is type tested	Yes
Whether facility is provided with pressure relief	Yes
Insulating gas	SF6
Nominal operating gas pressure	1.4 bar abs. 20° C
Gas leakage rate / annum %	<0.1 % per annum
Expected operating lifetime	30 years
Whether facilities provided for gas monitoring	Yes, temperature compensated manometer
Material used in tank construction	Stainless steel sheet, 2 mm Non-Magnetic, Non-ferritic

Means of switch operation	separate handle
Means circuit breaker operation	handle and push buttons
Rated operating sequence of Circuit Breaker	O-0.3s CO 15s CO
Total opening time of Circuit Breaker	approx. 40-80ms
Closing time of Circuit Breaker	approx. 40-70ms
Mechanical Endurance class of Switch & Circuit Breaker	M1
Electrical Endurance Class: Vacuum Circuit Breaker Load Break Switch Earth Switch	 E1 E3 E2
Principle Switch Disconnector.	2 position puffer switch

4.1.3 No Operations, Degree of Protection and Colours
Degree of protection:

High Voltage live parts,	SF6 tank IP 67
Front cover mechanism	IP 2X
Cable covers	IP 3X
Overall Enclosure	IP 54

Colours:

Front cover	RAL 7035
Side and cable cover	RAL 7035
Enclosure	Dark Admiral Grey

4.2 GENERAL STRUCTURAL AND MECHANICAL CONSTRUCTION

The offered RMU should be of the fully arc proof metal enclosed, free standing, floor mounting, flush fronted type, consisting of mo̅dules assem̅bled into one or more units. Each unit is made of a robotically welded sealed-for life stainless steel tank of thickness not less than 2 mm filled with SF6, containing all high voltage components sealed off from the environment with Ingress protection IP67.The enclosure should meet the "sealed pressure system" criterion in accordance with IEC 62271-200 standard (i.e. a system for which no handling of gas is required throughout the 30 years of service life), with provision of refilling the gas at site if necessary. In addition, manufacturer shall confirm that maximum leakage rate is lower than 0.1% per year. All SF6 enclosures have to pass the leakage test with Helium, before being gas filled with SF6. Due to the characteristics of Helium this test will detect any leakage. The overall design of the switchgear should be such that front access only is required. It should be possible to erect the switchboard against a substation wall, with HV and LV cables being terminated and accessible from the front.

RMU must have a pressure relief device at the bottom of the stainless steel housing to ensure that in the rare case of an internal arc, the high pressure caused by the arc will be released and the hö̈t gases a̋re allowed to be exhausted out at the

bottom of the cubicle towards back side to ensure complete safety to the operator. A controlled direction of flow of the hot gas should be achieved.

4.3 DIELECTRIC MEDIUM

SF6 gas shall be used for the dielectric medium for 11kV RMU's in accordance with IEC376. It is preferable to fit an absorption material in the tank to absorb the moisture from the SF6 gas and to regenerate the SF6 gas following arc interruption. The SF6 insulating medium shall be constantly monitored via a temperature compensating gas pressure indicator offering a simple go, no-go indication. Maximum gas pressure shall be 1.4 bars absolute.

4.4 LOAD BREAK SWITCH (630 Amp cable feeder)

It should consist of an SF6 cubicle housing a switch disconnector and an earthing switch. Bus bars and all electrical connections are located inside the tank. The switch positions are closed open earthed. The operating shafts for the switches should be have rotary seals where they enter the SF6 cubicle. The operating mechanisms should be located outside on the front of the SF6 tank. Cable bushings should be site-replaceable and located on the front of the SF6 cubicle in a separate cable compartment. Front covers containing the mimic diagram and having a degree of protection IP2XC close the fronts.

4.5 CIRCUIT BREAKERS(630 Amp Transformer feeder)

The 630Amp T-off circuit breaker module should consist of an SF6 cubicle housing a fixed type vacuum circuit breaker and a series disconnector &earthing switch. An integrated relay and related CTs is used for tripping of the circuit breaker. Bus bars and all electrical connections should be located inside the tank. The operating shafts for the switch disconnector should have rotary seals where they enter the SF6 cubicle. The operating mechanisms are located outside on the front of the SF6 tank. Bolted type cable bushings should be site-replaceable and located on the front of the SF6 cubicle in a separate cable compartment. Front covers containing the mimic diagram having a degree of protection IP2XC seal off the fronts. Vacuum bottles should be used as interrupters of the currents. The make of vacuum bottles should be same as that of RMU. The circuit breaker main circuit should be connected in series with a three-position disconnector earthing switch. The operation between circuit breaker and disconnector earthing must be interlocked. VCB shall use a self-powered relay with low burden trip coil. Relay shall draw the required energy from ring core CTs mounted on cables in the cable compartment.

4.6 EARTHING OF THE MAIN CIRCUIT

Each disconnector/VCB shall be provided with an integral earth switch. Earthing switches should be rated equal to the switchgear rating. Earthing switches should be quick make type capable of making Rated Fault Current. Earthing switch should be operated from the front of the cubicle by means of a removable handle. The earthing switch can be closed only when the disconnector is open. Mechanical interlocking systems shall prevent all operator errors such as closing the earth switch when switch is closed. The HT cables are terminated in the dedicated cable compartment. At the bottom of the cable compartment, an earthing bar system made of copper with a minimum cross section of 120 sqmm should be fitted.

4.7 OPERATING MECHANISMS & INTERLOCKING

All mechanisms should be situated in the mechanism compartment outside the SF6-tank and behind the front covers with degree of protection of IP2X.This gives the opportunity of easy access to all operating mechanisms if retrofit or service should be required. The speed of operation of these mechanisms is independent of how fast the handle is operated. All units shall be equipped with interlocked cable covers. This will prevent access to the cable compartment before earthing switch is in closed position. It will also be impossible to operate switch disconnector to closed position before cable compartment cover is put back in place.

Each switch mechanism is equipped with a padlocking device. When adding a padlock to this device, the access to operate the mechanism will be prevented. This device has three holes with diameter 9 millimeter. All operating mechanisms are equipped with true position indicators for all switches. In order to safeguard true indication, indicators are directly connected to the operating shafts of the switches inside the SF6 tank. Operating handle shall have an anti-reflex system which prevents an immediate re-operation of the switch. In rare case of mechanism failure, it shall be possible to replace the same at site without requiring SF6 gas refilling.

4.7.1 Load Break Switch Mechanism

The mechanism shall have two operating shafts; the upper one for the load break switch and the lower one for the earthing switch. Both shafts are single spring operated and are directly connected to the switches inside the SF6 enclosure.

Due to the mechanical interlock between the upper and the lower operating shaft, it is impossible to operate the load break switch when the earthing switch is in earthed position or to operate the earthing switch when the load break switch is in closed position.

4.7.2 Breaker Mechanism

This module has two mechanisms; the upper one is for circuit-breaker and the lower one with two operating shafts is for disconnector and earthing switch. The breaker mechanism can be charged by motor or manually by the integrated charging lever. The vacuum circuit-breaker has the possibility of rapid auto-reclosing duty. By means of mechanical push buttons it is possible to close and open the circuit breaker. The opening spring is always charged when the circuit-breaker is in closed position and will be ready to open immediately if the protection relay gives a trip signal. If the mechanism is recharged after closing, it is possible to perform open - close - open sequence. The lower mechanism is identical to the load break switch module. There is a mechanical interlock between these two mechanisms which prevents operation of the disconnector and the earthing switch when the circuit-breaker is in closed position. When the earthing switch is in closed position it is impossible to operate the disconnector, but the circuit-breaker can be closed for testing purposes.

4.8 BUSBARS

Comprising the 3 single phases copper bus bars and the connections to the switch or circuit breaker. The bus bar should be integrated in the cubicle Bus bars should be rated to withstand all dynamic and thermal stresses for the full length of the switchgear.

4.9 FRONT COVERS

Upper and lower front covers shall be manufactured with 2 millimeter Aluzinc and covered with a polycarbonate foil. These foils contain the mimic diagram of the main circuit with the position indicators for the switching devices. Background colour for these foils is grey RAL 7035, which makes the black single line diagram to stand out for easy optical reading of position indicators. Both the upper and lower front covers are removable. The voltage indicators are situated on the front panels.

4.10 POSITION INDICATORS

The position indicators shall be visible through the front cover and must be directly linked to the operating shaft of the switching devices. The operator shall be able to confirm the closing of earth switch. Same can be accomplished either by providing a viewing window for earth switch or by means of true position indication duly type tested as per IEC 62271-102 sub clause A.6.105 to verify proper functioning of position indicating device.

4.11 VOLTAGE INDICATORS

The voltage indicators are situated on the front cover, one for each module, and indicate the voltage condition of each incoming cable. Identification of the phases is achieved with labels L1, L2 and L3 on the front of the voltage indicators. The voltage indicator satisfies the requirements of IEC61243.

412 CABLE COMPARTMENT

It should be possible to terminate up to a 1x 3C x300 mm^2 core HV cables in each cable compartment. The cable compartments should be in front and cable entry shall be from bottom. The access to the compartment will be possible by removing the cable cover only when earth switch is ON. Cable Compartments should be Arc Proof and interlocked with respective Earth Switches. Each module has a separate cable compartment that is segregated from each other by means of a partition wall. A partition wall should be fitted to divide the cable compartment from the rear side of the switchgear. In case of an arc inside the tank, followed by the opening of the pressure relief, the partition wall prevents the hot gases flowing out from the pressure relief to enter the cable compartments. All covers are removable. It should be possible to perform cable testing inside the cable boxes without disconnecting the cables.

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4.13 CURRENT TRANSFORMER

All current transformers should be complying with IEC 60185.

Current transformers should be of ring core, dry type, with ratings and ratios as required. Cable current transformers used in circuit breaker modules should be maximum 100mm wide and shall have sufficient VA burden for operation of self powered relays and low energy trip coil. Current transformers shall be placed in the cable covers so that it can be easily replaced at site without removing the bushings. The CT shall be 5P20 with burden 2.5VA for protection class.

Further characteristics and features of Instrument Transformers used for metering and protection are listed as follows:

Metering Current Transformers:

a) Type: . .Ring Type

b) Material:, Resin Cast
c) Burden: 30 VA
d) Ratio: 400-200/5 Amps
e) Accuracy Class for metering: 0.5

Protection Current Transformers:
a) Type: Ring Type
b) Material: Resin Cast
c) Burden: 30 VA
d) Ratio: 400-200/5 Amps
e) Accuracy Class for protection: 5P10.

Metering of Potential Transformers:
a) Type: Ring Type
b) Material: Resin Cast
c) Burden: 100 VA
d) Ratio: 33 kV/√3 /110V/√3
e) Accuracy Class for metering: 0.5

Auxiliary Potential Transformers for Battery and Battery chargers:
Auxiliary Potential Transformer 33kV/√3 / 230V with 500VA burden for 230V AC supply
HRC fuses shall be provided in PTs 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.

4.14 AUXILIARIES
The switchgear should be prepared for options like motor operation, auxiliary contacts and short-circuit indicators. Necessary terminal blocks and wiring etc. should be placed behind the front cover or in LV box of each module.

4.15 FAULT PASSAGE INDICATORS (FPI).
These 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 unit should be self-contained requiring no auxiliary power supply. The Fault passage indicators (FPI) shall facilitate for detection of short circuit fault and earth fault through current transformer inbuilt in Fault Passage Indicators. The FPI shall be integral part of RMU to avoid thefts. The FPI shall have clear display, automatic reset facility and shall be SCADA compatible.

4.16 SCADA Integration

a. PHILOSOPHY
i. It is intent of this project to ensure remote monitoring of electrical supply via suitable SCADA setup. The objectives include:
1. Monitoring and control of all HT Feeders (Substation feeders, ring-feeders and transformer feeders).
2. By monitoring, it means real time availability of following feeder status: ON, OFF,

TRIP
3. By control, it means, 'Fail-safe", 'minimum-lag' execution of ON/OFF command with feedback of successful execution or error.
ii. SCADA Integration Unit shall be setup with each Compact Substation to act as an interface between Feedbacks and Signals of CSS and Upper Level SCADA software.
iii. Field Remote Terminal Unit (F-RTU) will be at the heart of this communication architecture, having requisite capability to:
1. Control and Monitor required commands and feedbacks
2. To capture Trafo mains Multifunction Meter data on HV and LV side
3. To establish and maintain communication with upper level SCADA and decided open protocol.

4. To allow secured engineering level access to SCADA implementation agency for configuring and establishing the required communication architecture. Necessary software included in scope of supply.
5. To allow secured operator level access to verify SCADA operation and preview web-HMI built into the FRTU (TCP/IP) and take local dumps of data logs (if applicable).
iv. SCADA Integration Unit will be a segregated and lockable compartment, containing following items:
1. Terminal Blocks and to receive potential free feedbacks from and issue potential free commands to various parts of CSS as per Specific Requirement
2. Suitable Terminal Blocks to act as junction between Mod Bus RTU wiring of 02 Nos. Multifunction Meters and FRTU
3. Dedicated battery bank with charging arrangement to provide at least 04-hourbackup to various items of SCADA integration unit. Battery sizing calculation to be provided for approval of Engineer-in-charge.
The 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
The battery charger input voltage range shall be from 140V – 230 V AC or a suitable rating Automatic voltage stabilizer shall be installed in the Metering/SCADA cubicle to give rated 230V AC for battery charging.

4.Field Remote Terminal Unit as per specification given below.
5.Light Interface Unit with patch cord to interface FRTU with external armored FO cable.
6. Aux. Items such as:
   a. Control Switches: Local/Remote two position switch, Isolation DC MCB, Isolation AC MCB
   b. Local Indications: System on Local, System on Remote Communication Error, AC Supply Fail, DC Supply Fail
   c. Grounding arrangements: Special and dedicated earthing to be provided for grounding electronic equipment
   d. Suitable measures (such as transparent polycarbonate sheet etc.) to prevent accidental contact with terminal blocks during normal operating conditions.
   e. Auto cut-off DC LED Lamps of adequate rating to provide required illumination inside the cabinet during night conditions (lamp load to be included in battery sizing calculation)

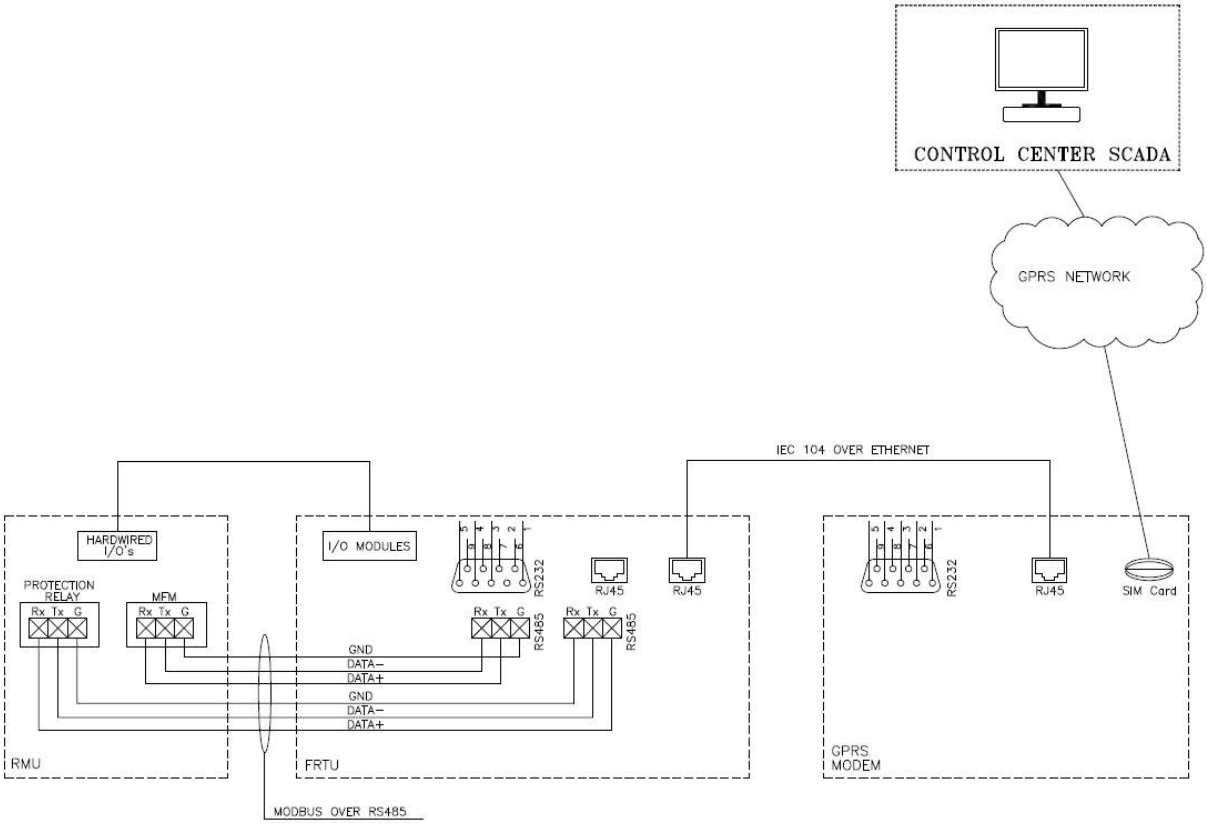
f. Hinged door with at least 90 degree opening span, providing at least IP4X protection during closed door condition.

A Typical List of signals to be integrated with the SCADA Control center is attached

TYPICAL DATA LIST OF 11KV 3WAY RMU

SL. NO.	VOLT. LEVEL	RMU LOCATION	DEVICE IDENTIFICATION	POINT DESCRIPTION	DATA TYPE	SIGNAL TYPE HARD / SOFT
	LBS Module-1					
1	11 KV		LBS	LBS OPEN/CLOSE STATUS	DPS	HARD
2	11 KV		ESW	EARTH SWITCH OPEN/CLOSE STATUS	SPS	HARD
3	11 KV		FPI-SC	FPI S/C	SPS	HARD
4	11 KV		FPI-EF	FPI E/F	SPS	HARD
5	11 KV		VPIS	VOLTAGE PRESENT	SPS	HARD
6	11 KV		SF6	SF6 GAS PRESSURE LOW	SPS	HARD
7	11 KV		LBS-LR	LBS L/R SWITCH IN REMOTE	SPS	HARD
8	11 KV		CAB-COM	CABLE COMPARTMENT DOOR STATUS	SPS	HARD
9	11 KV		MFT	MFT HEALTHY	SPS	SOFT
10	11 KV		KV-RY	VOLTAGE - RY	AI	SOFT
11	11 KV		KV-YB	VOLTAGE - YB	AI	SOFT
12	11 KV		KV-BR	VOLTAGE - BR	AI	SOFT
13	11 KV		AMP-RPH	CURRENT - R-PH	AI	SOFT
14	11 KV		AMP-YPH	CURRENT - Y-PH	AI	SOFT
15	11 KV		AMP-BPH	CURRENT - B-PH	AI	SOFT
16	11 KV		FREQ	FREQUENCY	AI	SOFT
17	11 KV		MW	ACTIVE POWER (P)	AI	SOFT
18	11 KV		MW-RPH	ACTIVE POWER (P) - R-PH	AI	SOFT
19	11 KV		MW-YPH	ACTIVE POWER (P) - Y-PH	AI	SOFT
20	11 KV		MW-BPH	ACTIVE POWER (P) - B-PH	AI	SOFT
21	11 KV		MVAR	REACTIVE POWER (Q)	AI	SOFT
22	11 KV		MVAR-RPH	REACTIVE POWER (Q) - R-PH	AI	SOFT
23	11 KV		MVAR-YPH	REACTIVE POWER (Q) - Y-PH	AI	SOFT
24	11 KV		MVAR-BPH	REACTIVE POWER (Q) - B-PH	AI	SOFT
25	11 KV		MVA	APPARANT POWER (S)	AI	SOFT
26	11 KV		PF	POWER FACTOR	AI	SOFT
27	11 KV		LBS	LBS OPEN/CLOSE COMMAND	DPC	HARD
28	11 KV		FPI	FPI RESET	SPC	HARD
	LBS Module-2					
1	11 KV		LBS	LBS OPEN/CLOSE STATUS	DPS	HARD
2	11 KV		ESW	EARTH SWITCH OPEN/CLOSE STATUS	SPS	HARD
3	11 KV		FPI-SC	FPI S/C	SPS	HARD
4	11 KV		FPI-EF	FPI E/F	SPS	HARD
5	11 KV		VPIS	VOLTAGE PRESENT	SPS	HARD
6	11 KV		LBS-LR	LBS L/R SWITCH IN REMOTE	SPS	HARD
7	11 KV		CAB-COM	CABLE COMPARTMENT DOOR	SPS	HARD

				STATUS		
8	11 KV		MFT	MFT HEALTHY	SPS	SOFT
9	11 KV		KV-RY	VOLTAGE - RY	AI	SOFT
10	11 KV		KV-YB	VOLTAGE - YB	AI	SOFT
11	11 KV		KV-BR	VOLTAGE - BR	AI	SOFT
12	11 KV		AMP-RPH	CURRENT - R-PH	AI	SOFT
13	11 KV		AMP-YPH	CURRENT - Y-PH	AI	SOFT
14	11 KV		AMP-BPH	CURRENT - B-PH	AI	SOFT
15	11 KV		FREQ	FREQUENCY	AI	SOFT
16	11 KV		MW	ACTIVE POWER (P)	AI	SOFT
17	11 KV		MW-RPH	ACTIVE POWER (P) - R-PH	AI	SOFT
18	11 KV		MW-YPH	ACTIVE POWER (P) - Y-PH	AI	SOFT
19	11 KV		MW-BPH	ACTIVE POWER (P) - B-PH	AI	SOFT
20	11 KV		MVAR	REACTIVE POWER (Q)	AI	SOFT
21	11 KV		MVAR-RPH	REACTIVE POWER (Q) - R-PH	AI	SOFT
22	11 KV		MVAR-YPH	REACTIVE POWER (Q) - Y-PH	AI	SOFT
23	11 KV		MVAR-BPH	REACTIVE POWER (Q) - B-PH	AI	SOFT
24	11 KV		MVA	APPARANT POWER (S)	AI	SOFT
25	11 KV		PF	POWER FACTOR	AI	SOFT
26	11 KV		LBS	LBS OPEN/CLOSE COMMAND	DPC	HARD
27	11 KV		FPI	FPI RESET	SPC	HARD
	CB Module-1					
1	11 KV		CB	CB OPEN/CLOSE STATUS	DPS	HARD
2	11 KV		ESW	EARTH SWITCH OPEN/CLOSE STATUS	SPS	HARD
3	11 KV		VPIS	VOLTAGE PRESENT	SPS	HARD
4	11 KV		SPCH	SPRING CHARGE	SPS	HARD
5	11 KV		CAB-COM	CABLE COMPARTMENT DOOR STATUS	SPS	HARD
6	11 KV		RMU-DSW	RMU PANEL DOOR SWITCH STATUS	SPS	HARD
7	11 KV		OCEF-OPTD	O/C & E/F OPERATED	SPS	HARD
8	11 KV		CB-LR	CB L/R SWITCH IN REMOTE	SPS	HARD
9	11 KV		OC-OPTD	O/C OPERATED	SPS	SOFT
10	11 KV		EF-OPTD	E/F OPERATED	SPS	SOFT
11	11 KV		CB	CB OPEN/CLOSE COMMAND	DPC	HARD
12	11 KV		PRTN-RESET	PROTECTION RELAY RESET	SPC	SOFT
	COMMON					
1	AUX		24V DC-FAIL	24V DC FAIL ALARM	SPS	HARD
2	AUX		BCHG AC-FAIL	BATTERY CHARGER AC FAIL ALARM	SPS	HARD
3	AUX		BCHG-FAIL	BATTERY CHARGER FAIL	SPS	HARD



f. FIELD REMOTE TERMINAL UNIT

i. The RTU system shall be responsible to collect process information and control the substation equipment via different communication protocols described in this specification. The unit consist of a compact solution all required communication units like CPU, multi-I/O Modules and power supply in a single scalable DIN-Rail housing.

ii. The assembling of the RTU should be available in centralized architecture or in a de-centralized way with remote I/Os distributed Modules.

iii. The equipment shall have front access to indicate operational and error states by light emitting diodes on the front plate. The electronic modules shall be labelled in the front using the same name as indicated in the technical documentation.

iv. The equipment shall be designed to restart automatically after power failure. It shall not be necessary to manually restart the equipment after the recovery of the auxiliary power source.

v. Hardware Design

1. The RTU shall be microprocessor-based and shall be covered inside DIN rail mountable modules or in scalable housings. The CPU board will be responsible for the main processing tasks and for the communication incl. Reading/Writing process events/commands from the I/O boards, Communication to control center and to subordinated devices Managing of the time base and synchronizing the I/O boards. Each CPU board shall have a 32-bit main processor.

The RTU shall be capable of handling more than 2000 data points, with CPU equipped with at least 400 Hz Processor, 256 MB RAM and 8 Mb Flash/EE Prom Memory. Programs and configurations shall not require reloading due to power outage. It must be possible to easily change or update the firmware to implement enhancements or change protocols.

2. The CPU board should have 2 to 4 serial ports (RS485/RS232-C) which can be configured separately with multi protocols. Each CPU board shall be equipped with up to 2 Ethernet interface for the download of configuration / firmware files from a local or remote computer. It shall also be possible to transfer the configuration of an RTU to a local or remote computer. With the Ethernet interface it shall also be possible to perform a remote diagnostic of the RTU and Ethernet based communication to higher and lower equipment.

vi. The RTU DIN-Rail shall provide Data Archives in order to save datalike system events from the RTU, process events, measuring values, pulse counter values. with the time-stamp with 1 ms resolution in the data archive which will be saved power-fail-save in the Flash/EProm memory of the RTU and shall be locally and remotely accessible.

vii. The central processor shall include a real time clock with the possibility to be synchronized by external GPS equipment or from the operation control center via a periodically transmitted synchronization instruction with a communication protocol supporting this function.

viii. Each I/O device shall be equipped with its own microprocessor which takes over a part of the data processing, e. g. digital filter for binary inputs, threshold supervision for analog inputs, etc. and shall also have their own times which are synchronized by the CPUs periodically via the I/O bus, in order to provide time stamping of events and analog values with an accuracy of +/-1ms within the RTU.

ix. The inputs shall be potentially isolated by the means of optical couplers. Direct connection to the input and output process signals voltages are available with 24..60VDC and 110..125VDC nominal voltages without the need of interposing components.

x. The RTU DIN-Rail main power supply is nominal 24VDC.With basic features such as potential isolation between inputs and outputs, cooling by natural convection, short-circuit proof, over voltage protection, controlled load balancing, alarm indication in case of failure.

3. There shall be a minimum of 20% spare capacity of I/O signals available on each FRTU for the purpose of future expansion.

xi. **Functional Requirement.**

1. Communication with Control Centers

a. The RTU DIN-Rail must be capable of communicating with a Master Station using the tele-control communication protocol IEC 60870-5-104 over TCP/IP. It must be possible to communicate simultaneously with multiple Master Stations as a communication Gateway Interface, using different communication protocols (e.g serial communication via RS232 and or RS485 standard ports, and min. one 10/100 Base T port for Ethernet communication) All communication interfaces shall be accessible on the front side provided as RJ45 jacks integrated in the board`s front plate.

2. **Communication at Station Level - IEC61850**

a. If required, the RTU DIN-Rail shall support the communication via IEC61850 station bus. The RTU shall provide IEC61850 client and server functionality.

3. **Communication with IEDs**

a. The RTU DIN-Rail shall also provide serial / Ethernet interfaces for the communication with subordinated devices like intelligent electronic devices (IEDs). Digital protection relays, metering devices or subordinated RTUs shall be connectable. Communication should be possible over IEC 60870-5-101, IEC 60870-5-103, DNP 3 level 2, Modbus. etc.

4. **Communication via GPRS Modem**

a. The RTU DIN-Rail provider optionally support an integrated 4-G Modem

in their RTU DIN-Rail solution. A radio interface via 4G Modem and pluggable 4G SIM Card is necessary. The connection to an external antenna is also part of the option.

xii. Time Management and Synchronization

1. The internal time management shall be controlled by the CPU communication board. The time resolution of the RTU DIN-Rail shall be 1 ms for events, scanned by the directly connected I/O board.
2. Synchronization with absolute time should be possible by Time synchronization of the RTU DIN-Rail by the network control centre (NCC) via a periodically transmitted synchronization instruction with a communication protocol supporting this function, or Time synchronization of the RTU DIN-Rail using SNTP V4 (RFC2030) on a LAN/WAN network.
3. If required, a time synchronized RTU DIN-Rail shall be able to synchronize subordinate RTUs and IEDs via a periodically transmitted synchronization instruction with a communication protocol supporting this function.

xiii. Archive Function

1. The RTU DIN-Rail shall be able to handle archive data and shall be protected against voltage loss.
2. RTU should be able to handle following data with time stamp:
   a). Process events of the RTU and connected subsystems (subordinate RTU'S,IED's, protection relays),if applicable
   b). Virtual data points.
   c). User-login
   d). Commands
   e). System events and messages.
   f). Analogue measured values
   g). Integrated totals (counter values) etc.
3. The file archive should be able to handle Disturbance recorder files, Load profiles of connected metering devices (e.g.IEC62056-21), disturbance recorder of connected subordinated RTUs with IED's etc.
4. Upload to a flash memory shall be possible.
5. Sequence of Events (SOE):
   Time Resolution - 10 ms minimum
   Buffer Size – 10,000 events minimum

xiv. Diagnostics

1. All RTU modules, at minimum all Input modules, shall have light emitting diodes (LEDs) to indicate errors or operating modes.
2. The application data shall be stored on Compact Flash Cards which makes it possible to exchange modules without new
configuration download.
3. The functional operation of the RTU DIN-Rail shall be guaranteed by a comprehensive monitoring concept. The hardware and software shall be continuously monitored from the I/O modules throughout the entire RTU DIN-Rail.
4. The RTU DIN-Rail shall report its system and error states to the Control Center by means of System Events.
5. The RTU DIN-Rail shall provide remote diagnostics capabilities, e.g. by means of a Web-Server via LAN/WAN.

xv. Security

1. The following security functions shall be included in the RTU:
User Account Management (UAM), integrated in the Web server User Activity Logging (UAL) on the Compact Flash® of the CMU Closing of unused TCP/IP ports Enabling/disabling

of Web server use individually per CMU.

All the above security features fulfill basic requirements of the following security standards: NERC/CIP, North American Electric Reliability Corporation Critical Infrastructure Protection, IEC 62351, IEEE 1686 etc.

xvi. Tools

1.Configuration tool
a. The supplier shall provide a suitable software tool for the configuration and database programming of the RTU DIN-Rails. The tool shall be state-of-the-art, running on standard desktop or laptop computers, and shall be based on Windows. All related RTU DIN-Rail software must be HW independent and not related to the different type or architecture of the RTU DIN-Rails.
b. The user interface shall be an application according to Microsoft standard presentation format.
c. The configuration tool shall contain an online documentation for easy handling.
d. It also shall provide an Excel import data interface that enables the user to use Excel sheets to manage RTU configuration data and processing parameters.

RTU design should be type-tested for adequate performance as per following details:

Item	**Standard**	**Test Level**
1	Insulation resistance according IEC 60255-5	>100MOhm / 500V DC
2	Insulation dielectric withstand voltages according IEC 60255-5 (IEC 60870-2-1 class VW3, ANSI/IEEE C37.90-1989, 1,5kV)	2,5kV, 50Hz, 1min
3	Insulation impulse voltage	

Item	**Standard**	**Test Level**
1	Low Temperature (IEC 60068-2-1)	-25°C
2	High Temperature (IEC 60068-2-2)	+70°C
3	Temperature-Humidity (IEC 60068-2-30, cyclic test)	95%
4	Vibration response test, sinusoidal: IEC 60068-2-6 IEC 60255-21-1 Class 1 0,5g (10	0,5g (10 150 Hz)

viii. Safety, Insulation, EMC Immunity and CE Declaration

1. The RTU should be tested according safety standard IEC

Item	**Standard**	**Test Level**
1	Electro static discharge immunity (IEC 61000-4-2 level4) (IEC61000-6-2 8/6 KV) (IEC60255-22-2 8/6 KV) (ANSI/IEEE C37.90.3-2001,8KV)	Cubicle:15/8kV Modules: 8/6kV

2	Radiated Electromagnetic Field (IEC 61000-4-3) (IEC 60870-2-1-A 5.1 level 3) (IEC 61000-6-2 10 V/m) (IEC 60255-22-310 V/m)	10 V/m Level 3
3	Electrical Disturbances 1 MHz Burst IEC 60255-22-1 IEC61000-4 IEC61000-18	2.5KV CM, 1.0KV DM
4	Fast Transient Burst Immunity IEC 61000-4-4 (IEC 60870-2-1 A2.3 level 4) (IEC61000-6-2 A/D=2kV, S=1kV) (IEC 60255-22-4 4kV) (ANSI/IEEE C37.90.1-2002, 4kV)	4kV Level 4
5	Surge Immunity IEC 61000-4-5 (IEC 60870-2-1 A2.2 level 3) (IEC61000-6-2 A=1/2kV, S=1kV) (IEC 60255-22-3 2kV	2kV Class 3
6	Feeder Distributed RTU IEC 61000-4-5 (IEC 60870-2-1 A2.2 level 4) (IEC61000-6-2 A=1/2kV, S=1kV) (IEC 60255-22-3 2kV)	4 kV Class 4
7	Conducted RF Disturbance Immunity IEC 61000-4-6 IEC61000-6-2 10V) (IEC 60255-22-6 10V)	10 V Level 3
8	Pulse Magnetic Field Immunity IEC 61000-4.9	1000A Level 5

EMC Emission Tests

Item	Standard	Test Level
1	Enclosure: Radio Interference Field Strength IEC/CISPR 11 /EN50011	30dB (30 30MHz) 37dB (230 1000MHz)
2	Power Supply : Radio Interference Voltage IEC/CISPR 11 /EN50011	79dB (0,15- 0,5MHz) 79dB (0,5-30MHz)

5.0 MANUFACTURING FACILITY

The manufacturer shall ensure workmanship of high quality. There shall be adequate

machinery tools and tackles such that the product shall meet the internationally accepted standards. Facility should be certified for ISO 9001, 14001 and OHSAS 18001.The manufacturing facility shall be equipped with the following:

1. Robotic welding station for stainless steel main tank, ensuring a leak rate of less than 0.1% per year.
2. Work benches with pneumatic adjustable work benches and torques wrenches, giving flexibility to workmen for proper tightness of internal components of sealed tank.
3. State of the art fully automatic gas filling and leakage testing machine for ensuring the quality of sealing and have precision to measure leak rate less than 0.1% per year.
4. High voltage testing station to have high voltage power frequency test and partial discharge measurement.
5. Computerized system to measure time travel characteristic of breaker before sealing the tank.

6.0 TESTING AND CERTIFICATION

7.1 Type Tests

Units should be type tested in accordance with IEC standards 60056, 62271-102, 60265,62271-200, 62271-105,60529 and 60694. The following type tests have been performed and available if required

1. Short time and peak withstand current test.
2. 2. Temperature rise tests
3. Dielectric tests.
4. Test of apparatus i.e. circuit breaker and earthing switch
5. Arc fault test
6. Measurement of resistance of main circuit.
7. Mechanical endurance test.
8. Duty cycle test.
9. Internal arc test for HT chamber.
10. Degree of protection for IP 54 for Outdoor enclosure.
11. Tests to verify true position indication devices as per IEC 62271-102.

6.2 Routine tests

Routine tests should be carried out in accordance with IEC 62271-200 standards. These tests should be ensure the reliability of the unit. Below listed test should be performed as routine tests before the delivery of units:

1. Withstand voltage at power frequency
2. Measurement of the resistance of the main circuit Partial discharge test for the tank
3. Withstand voltage on the auxiliary circuits
4. 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
5. Verification of wiring
6. Visual inspection
7. Time travel characteristics measurement facility for Breaker should be available with the manufacturer to assess the quality of RMU.

7.0 DOCUMENTATION

An instruction manual should be provided with necessary information for receiving, handling, storage, installation, operation and maintenance. Routine test certificate should be follow each unit, and standard schematic drawings should be delivered for Ring Main Units. Compact Switchgear should have drawings that consist of system single line drawings, general arrangement and schematic drawings for order specific units. All drawings shall confirm to International Standards Organization (ISO) "A" series of drawing sheets/Indian Standards Specification IS : 11065. All dimensions and data shall be in ink and suitable for microfilming. All dimensions and data shall be in S.I. Units.

7.1 List of drawings and Documents

The bidder shall furnish four sets of relevant descriptive and illustrative published literature, pamphlets and the drawings for preliminary study along with offer.

1. General outline drawings showing dimensions and shipping weights, quantity of Insulating media.
2. Sectional views showing the general constructional features of the circuit breaker
3. Including operating mechanism, arcing chambers, and contacts with lifting dimensions for maintenance.
4. Drawings showing control cabinets and circuit diagrams for operating mechanism.
5. Schematic diagrams of breaker offered for control and supervision.
6. Structural drawings for support structures.
7. Foundation plan and loading data and foundation design.
8. Drawings showing the complete operation cycle of the Ring Main Unit with description.
9. Soft copies(Auto CAD &PDF Version) of all the drawings shall be submitted by the successful bidder.

8.0 NAME PLATE :

Each main RMU and it associated equipment's shall be provided with a name plate legible and indelibly marked with at least the following information .

1. Name of Manufacturer.
2. Type
3. Serial No.
4. Voltage
5. Current
6. Frequency
7. Symmetrical breaking Capacity
8. Making Capacity
9. Short time current and Its duration
10. Purchase Order No. and Date.
11. Month and Year of Supply
12. Rated Lighting Impulse withstand voltage.

9.0 CHALLENGE CLAUSE:

The Purchaser reserves the right to have the material, received after inspection by the authorized inspecting officer, again tested for any parameter(s) from approved/NABL accredited testing house/in house technique of the purchaser. The

results if found deviating/unacceptable or in non-compliance with the approved GTP'S, the lot shall be rejected and bidder shall arrange to replace the rejected lot within thirty (30) days of such detection at his cost including to & fro transportation".

10.0 GUARANTEED TECHNICAL PARTICULARS:

The bidder should fill up the details in schedule A – "Guaranteed Technical Particulars "and the statement such as "as per drawing enclosed"," as per KPDCL requirement", "as per IS" ,"as per specification "etc. shall be considered as details not furnished and such offers will be rejected.

Schedule-A

GENERAL TECHNICALPARTICULARS - 11kV RMU

Sl.No.	Descriptions	Details
1.0	**SWITCHGEAR ASSEMBLY**	
1.1	Make	
1.2	Type	
1.3	Reference Standard	IEC62271
1.4	Voltage (Normal/Max.) kV	11/12
1.5	Phase (Nos.)	3
1.6	Frequency(Hz)	50
1.7	Short Circuit Rating	
a)	Breaking Symmetrical(kA)	21
b)	Shorttimefor3Sec.	21
1.8	Insulation level	
a)	Impulse Withstand (kV peak)	75
b)	1minute 50Hz.VoltageWithstand (kV rms)	28
1.9	Metal Clad Construction	No
1.10	Degree of protection	IP67-TanK IP54-For Outdoor Enclosure
1.11	Switchgear completely wire and tested at factory	YES
2.0	**CONSTRUCTION**	**Outdoor**
2.1	Overall Dimensions	
i)	Length(mm)	As per GA drawings
Ii)	Breadth(mm)	As per GA drawings
Iii)	Height(mm)	As per GA drawings
2.2	Weight	As per GA drawings
3.0	**BUSBAR**	
3.1	Make	
3.2	Material &Grade	COPPER
3.3	Reference Standard	IEC
3.4a)	Cross Sectional area(mm)	$240mm^2$
b)	Size(mm)	
3.5	Continuous Current	
a)	Standard	630A(as per type-tested design)
b)	At site conditions and within cubicle	630A(as per type-tested design)
3.6	Maximum temperature rise over ambient(^0C)	105 total(40amb+65)
3.7	Short time current for3sec.(Ka rms)	21
3.8	Minimum clearance from bare busbar connection	
a)	Phase to phase(mm)	Suitable for the insulation mentioned in 1.8above
b)	Phase to earth(mm)	
3.9	Busbar provided with -	
a)	Insulation Sleeve	Bus bars are in SF6environment inside a robotically sealed stainless steeltank
b)	Phase barriers	
c)	Cast Resin shrouds for joints	

3.10	Busbar connection	
a)	Silver Plated	NA
b)	Made with anti oxide grease	NA
3.11	Busbar support spacing (mm)	suitable for insulation
3.12	Busbar support insulators	Not applicable
4.0	**SF6 /VCB**	**VACUUM**
4.1	Make	
4.2	Type	Vacuum Circuit Breaker
4.3	Reference Standard	IEC62271-100
4.4	Rated Voltage	12
4.5	Rated Frequency	50
4.6	No. of poles	3
4.7	Rated Current	630A(as per type-tested design)
4.8	Maximum temperature rise over ambient ^0C	105 total(40amb+65)
4.9	Rated operating duty	O-0.3sec-CO-3min-CO
4.10	Rupturing capacity at rated voltage(MVA)	400
4.11	Breaking capacity at rated voltage &operating duty	21kA
4.12	Rated making Current(kA peak)	52.5
4.13	Short time current for3Sec.(kArms)	21
4.14	Transit Recovery Voltage	
a)	Rate of rise (kV/ms)	0.34KV/micro sec(as per
b)	Peak voltage (kV)	23(35%DCcomponent)
4.15	Insulation Level	
a)	Impulse voltage with stand on 1/50 full wave	75
b)	1minute 50Hz. Voltage with stand	28
4.16	Maximum overvoltage factor when switching off	As perI EC
4.17	Opening time maximum No load condition (ms)	40-60ms
4.18	Opening and closing time under SF6 gas loss or vacuum loss condition (ms)	40-60ms
4.19	At 100% Breaking capacity	
a)	Opening time- Max.(ms)	49.2ms
b)	Arcing time- Max.(ms)	6.5ms
c)	Total break time (ms)	58.9ms
4.20	At 60%Breaking capacity	
a)	Opening time- Max.(ms)	48.9ms
b)	Arcing time- Max.(ms)	7.8ms
c)	Total break time (ms)	56.6ms
4.21	At30%Breaking capacity	
a)	Opening time- Max.(ms)	48.9ms
b)	Arcing time- Max.(ms)	8.1ms
c)	Total break time (ms)	57.7ms

4.22	At 10%Breaking capacity	
a)	Opening time- Max.(ms)	48.9ms
b)	Arcing time- Max. (ms)	8.1ms
c)	Total break time (ms)	57.7ms
4.23a)	Make time(Max)(ms)	40-80ms
b)	Total closing time (ms)	40-70ms
4.24	Number of breaks per pole	Single
4.25	Total length of breaks per pole(mm)	8+/- 1mm
4.26	Total length of contact travel(mm)	8+/- 1mm
4.27	Speed of break(100%short circuit current)	NA
4.28	Rate of contact travel	NA
4.29	No. of breaker operations	
a)	At100%ratedcurrent	2000
b)	At100%ratedbreakingcurrent	25No'sat 21KA
4.30	Type of contacts	
a)	Main	Copper Chromium, BUT T type.
b)	Arcing	
4.31	Material of contact	
a)	Main	Copper Chromium
b)	Arcing	
4.32	Contact pressure at No load (kg)	1260N(126 kg)
4.33	Type of arc control device provided	Vacuum
4.34	Operating mechanism - closing	
a)	Type	Stored energy or VC B and snap action for Ring Isolators
b)	No. of breaker operations stored	One
c)	Trip free of fixed type	Trip free
d)	Anti pumping features provided	Mechanical anti pumping
e)	Earthing for operating mechanism and metal parts furnished.	YES
f)	Earth terminal size and material	Copper 120 sqmm
4.35	Operating mechanism - tripping	
a)	Type	Stored energy or VCB and snap action for Ring Isolators
b)	No. of breaker operations stored	One
c)	Trip free of fixed type	Trip free
d)	Anti pumping features provided	Mechanical anti pumping
e)	Earthing for operating mechanism and metal parts furnished.	YES
f)	Earth terminal size and material	Copper 120 sqmm
4.36	Spring Charging Mechanism	
a)	Make	
b)	Type	El-MECHANISM
4.37	Breaker suitable for capacity switching]	
a)	Operating duty	SUITABLE FOR RING MAIN APPLICATION
b)	Max. rating of capacitor bank that can be safely controlled	SUITABLE FOR RING MAIN

.38	Tripping Coil	
a)	Voltage	24VDC
b)	Permissible voltage variation(%)	+/- 5%
c)	Tripping current at rated voltage(A)	6A
d)	Power at rated voltage(W)	150W
e)	2-OverCurrenttripwithTLF(5A) and1-earthfault furnished as specified	NA
4.39	Breaker/Accessories: Accessories such as control switch indication lamps etc. furnished as specified:(Please attach separate sheet giving details of all accessories, interlocks and safety shutters)	NA
a)	Mechanical Safety Interlock	YES
b)	Automatic Safety Interlock	NA
c)	Operation Interlock	YES
d)	Emergency manual trip	YES
e)	Operation counter	NO
f)	Charge / discharge indicator	YES (Cable Live indication)
g)	Manual spring charging facility	YES
4.40	Impact load foundation design (to included ead load plus impact value on opening at maximum interrupting rating) (kg)	NA
5.0	**ISOLATORS**	
5.1	Make	
5.2	Type	Fixed
5.3	Reference Standard	IEC62271-102
5.4	Rated Voltage(kV)	12
5.5	Rated Frequency(Hz)	50
5.6	No. of Poles (No.)	3
5.7	Rated current	630A(as per type-tested design)
5.8	Maximum temperature rise over ambient^{0}C	ASPER IEC
5.9	Rated Operation Duty	ASPER IEC
5.10	Rupturing capacity at rated voltage MVA	ASPER SPECIFICATIONS
5.11	Rated making current kApeak	
5.12	Short time current	
a)	for 1 sec.(kArms)	
b)	for 3 sec.(kArms)	
5.13a)	Impulse voltage withstand on 1/50 full wave	75
b)	1minute50Hzvoltagewithstand	28
5.14	Maximum overvoltage factor when switching off	
a)	Loaded feeder cable	ASPER IEC
5.15	MinimumSF6 Gas pressure required?	1.3BARAT20 Deg C
5.16	No. of isolator operation	
a)	At100%ratedcurrent	1000 CO (Mechanical) 100CO at630A rated current asper IEC
b)	At100%ratedbreakingcurrent	
5.17	Isolator provided with the following	
a)	Mechanical safety	Yes

	Mechanical ON, OFF, CABLE EARTH indicators	Yes
c)	Operation counter	No
d)	Manual spring charging facility	Snap Action
5.18	Impact load for foundation design(to include dead load plus impact values on opening at maximum interrupting rating) (kg)	NA
6.0	**CURRENTTRANSFORMER**	
6.1	Make	
6.2	Type & voltage level	Low Voltage
6.3	Reference Standard	IEC298
6.4	CT ratio as specified	Yes
6.5	Rated frequency	50
6.6	Short circuit withstand	
a)	Short time current for 3Sec.(kArms)	21
b)	Short time current for 5Sec.(kArms)	NA
c)	Dynamic current (kA peak)	52.5
6.7	Class of insulation	ASPER IEC
6.8	Temperature rise over ambient^{0}C	ASPER IEC
6.9	Basic insulation level	LTCT
6.10	For Tripping	
a)	CT Ratio- CT Ratio–	400-200/5A
b)	Class of Accuracy,	Class5P10for Protection, Class 0.5 for metering
c)	Rated burden VA	Burden 30 VA
7.0	Secondary wiring	
7.1	Type and insulation	Flexible coperwire1kV
7.2	Voltage grade	1kV
7.3	Conductor material	Copper
7.4	Conductor size(minimum)and insulation wiring	1sqmm&1kV
7.5	Wires identification at both ends with markers	
7.6	Wiring and other accessories provided as per specification	Yes
8.0	**CABLETERMINATIONS**	
8.1	Circuit Breaker	400SeriesBOLTEDTYPEBUSHINGSFORASPERDINSTANDARDSAREPROVIDED.
8.2	Isolator	
9.0	**Over Current and Earth Fault Protection Relay**	Self Powered
10.0	**Nameplate**	
10.1	Material	AL
10.2	Thickness	1mm
10.3	Size for	
a)	Breaker cubicle	Common rating plate shall be provided on RMU
b)	Instruments/devices	

11.0	Painting	7 tank process Subsequently powder coated with minimum thickness of 80microns
11.1	Finish of breaker Inside	Inside RAL 7035 Outside IS 632
	Outside	
11.2	Finish of isolator Inside Outside	Inside RAL 7035 Outside IS 632
12.0	Auxiliary PT for Battery and Battery Charger And	Auxiliary Potential Transformer11kV/√3//230V with 500VA burden for 230V AC supply HRC fuses shall be provided on the HV side
	BUS PT for Metering	11kV/√3//110V, Burden 50VA HRC fuses shall be provided on the HV side
	Insulation Material in PTs	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

(**To be filled by the bidder**)

GENERAL TECHNICALPARTICULARS - 11kV RMU

Sl.No.	Descriptions	Details
1.0	**SWITCHGEAR ASSEMBLY**	
1.1	Make	
1.2	Type	
1.3	Reference Standard	
1.4	Voltage (Normal/Max.) kV	
1.5	Phase (Nos.)	
1.6	Frequency(Hz)	
1.7	Short Circuit Rating	
a)	Breaking Symmetrical (kA)	
b)	Shorttimefor3Sec.	
1.8	Insulation level	
a)	Impulse Withstand (kVpeak)	
b)	1minute 50Hz.VoltageWithstand (kVrms)	
1.9	Metal Clad Construction	
1.10	Degree of protection	
1.11	Switch gear completely wire and tested at factory	
2.0	**CONSTRUCTION**	
2.1	Overall Dimensions	
i)	Length (mm)	
Ii)	Breadth (mm)	
Iii)	Height (mm)	
2.2	Weight	
3.0	**BUSBAR**	
3.1	Make	
3.2	Material &Grade	
3.3	Reference Standard	
3.4a)	Cross Sectional area (mm)	
b)	Size (mm)	
3.5	Continuous Current	
a)	Standard	
b)	At site conditions and within cubicle	
3.6	Maximum temperature rise over ambient('^{0}C)	
3.7	Short time current for3sec.(kA rms)	
3.8	Minimum clearance from bare busbar connection	
a)	Phase to phase (mm)	
b)	Phase to earth (mm)	
3.9	Busbar provided with -	
a)	Insulation Sleeve	
b)	Phase barriers	

c)	Cast Resin shrouds for joints	
3.10	Bus bar connection	
a)	Silver Plated	
b)	Made with anti-oxide grease	
3.11	Bus bar support spacing (mm)	
3.12	Bus bar support insulators	
4.0	**SF6 /VCB**	
4.1	Make	
4.2	Type	
4.3	Reference Standard	
4.4	Rated Voltage	
4.5	Rated Frequency	
4.6	No .of poles	
4.7	Rated Current	
4.8	Maximum temperature rise over ambient^{0}C	
4.9	Rated operating duty	
4.10	Rupturing capacity at rated voltage(MVA)	
4.11	Breaking capacity at rated voltage &operating duty	
4.12	Rated making Current(kA peak)	
4.13	Short time current for3Sec.(kArms)	
4.14	Transit Recovery Voltage	
a)	Rate of rise (kV/ms)	
b)	Peak voltage(kV)	
4.15	Insulation Level	
a)	Impulse voltage withstand on 1/50 full wave	
b)	1minute 50Hz. Voltage withstand	
4.16	Maximum over voltage factor when switching off	
4.17	Opening time maximum No load condition (ms)	
4.18	OpeningandclosingtimeunderSF6gaslossorvacuumloss condition (ms)	
4.19	At100% Breaking capacity	
a)	Opening time- Max.(ms)	
b)	Arcing time- Max.(ms)	
c)	Total break time (ms)	
4.20	At60%Breaking capacity	
a)	Opening time- Max.(ms)	
b)	Arcing time- Max.(ms)	
c)	Total break time (ms)	
4.21	At30%Breaking capacity	
a)	Opening time- Max.(ms)	
b)	Arcing time- Max.(ms)	
c)	Total break time (ms)	

4.22	At10%Breaking capacity	
a)	Opening time- Max.(ms)	
b)	Arcing time- Max. (ms)	
c)	Total break time (ms)	
4.23a)	Make time(Max) (ms)	
b)	Total closing time (ms)	
4.24	Number of breaks per pole	
4.25	Total length of breaks per pole(mm)	
4.26	Total length of contact travel(mm)	
4.27	Speed of break(100%short circuit current)	
4.28	Rate of contact travel	
4.29	No. of breaker operations	
a)	At100%ratedcurrent	
b)	At100%ratedbreakingcurrent	
4.30	Type of contacts	
a)	Main	
b)	Arcing	
4.31	Material of contact	
a)	Main	
b)	Arcing	
4.32	Contact pressure at No load (kg)	
4.33	Type of arc control device provided	
4.34	Operating mechanism - closing	
a)	Type	
b)	No. of breaker operations stored	
c)	Trip free of fixed type	
d)	Anti pumping features provided	
e)	Earthing for operating mechanism and metal parts furnished.	
f)	Earth terminal size and material	
4.35	Operating mechanism - tripping	
a)	Type	
b)	No. of breaker operations stored	
c)	Trip free of fixed type	
d)	Anti pumping features provided	
e)	Earthing for operating mechanism and metal parts furnished.	
f)	Earth terminal size and material	
4.36	Spring Charging Mechanism	
a)	Make	
b)	Type	
4.37	Breaker suitable for capacity switching]	
a)	Operating duty	
b)	Max. rating of capacitor bank that can be safely controlled	
4.38	Tripping Coil	
a)	Voltage	
b)	Permissible voltage variation(%)	

c)	Tripping current at rated voltage(A)	
d)	Power at rated voltage(W)	
e)	2-OverCurrenttripwithTLF(5A)and1-earthfault furnished as specified	
4.39	Breaker/Accessories:Accessoriessuchascontrolswitchindicationlampsetc.furnishedasspecified:(Pleaseattachseparatesheetgivingdetailsofallaccessories,interlocksandsafetyshutters)	
a)	Mechanical Safety Interlock	
b)	Automatic Safety Interlock	
c)	Operation Interlock	
d)	Emergency manual trip	
e)	Operation counter	
f)	Charge / discharge indicator	
g)	Manual spring charging facility	
4.40	Impact load foundation design(to include dead load plus impact value on opening at maximum interrupting rating) (kg)	
5.0	**ISOLATORS**	
5.1	Make	
5.2	Type	
5.3	Reference Standard	
5.4	Rated Voltage (kV)	
5.5	Rated Frequency (Hz)	
5.6	No .of Poles (No.)	
5.7	Rated current	
5.8	Maximum temperature rise over ambient ^{0}C	
5.9	Rated Operation Duty	
5.10	Rupturing capacity at rated voltage MVA	
5.11	Rated making current kA peak	
5.12	Short time current	
a)	for 1 sec.(kArms)	
b)	for 3 sec.(kArms)	
5.13a)	Impulse voltage withstand on 1/50 full wave	
b)	1minute50Hzvoltagewithstand	
5.14	Maximum over voltage factor when switching off	
a)	Loaded feeder cable	
5.15	MinimumSF6 Gas pressure required?	
5.16	No. of isolator operation	
a)	At100%ratedcurrent	
b)	At100%ratedbreakingcurrent	
5.17	Isolator provided with the following	
a)	Mechanical safety	
b)	Mechanical ON, OFF, CABLE EARTH indicators	
c)	Operation counter	
d)	Manual spring charging facility	

5.18	Impact load for foundation design (to include dead load plus impact values on opening at maximum interrupting rating) (kg)	
6.0	**CURRENTTRANSFORMER**	
6.1	Make	
6.2	Type & voltage level	
6.3	Reference Standard	
6.4	CT ratio as specified	
6.5	Rated frequency	
6.6	Short circuit withstand	
a)	Short time current for 3Sec.(kArms)	
b)	Short time current for 5Sec.(kArms)	
c)	Dynamic current (kA peak)	
6.7	Class of insulation	
6.8	Temperature rise over ambient ^{0}C	
6.9	Basic insulation level	
6.10	For Tripping	
a)	CT Ratio- CT Ratio–	
b)	Class of Accuracy,	
c)	Rated burden VA	
7.0	Secondary wiring	
7.1	Type and insulation	
7.2	Voltage grade	
7.3	Conductor material	
7.4	Conductor size (minimum)and insulation wiring	
7.5	Wires identification at both ends with markers	
7.6	Wiring and other accessories provided as per specification	
8.0	**CABLETERMINATIONS**	
8.1	Circuit Breaker	
8.2	Isolator	
	Over Current and Earth Fault Protection Relay	
10.0	**Nameplate**	
10.1	Material	
10.2	Thickness	
10.3	Size for	
a)	Breaker cubicle	
b)	Instruments/devices	
11.0	Painting	
11.1	Finish of breaker Inside	

	Outside	
11.2	Finish of isolator Inside Outside	
12.0	Auxiliary PT for Battery and Battery Charger And	
	BUS PT for Metering	
	Insulation Material in PTs	

B). TECHNICAL SPECIFICATION OF 33 KV, 3-WAY,OUTDOOR TYPE,SCADA COMPATABLE RING MAIN UNIT

1 SCOPE OF SUPPLY

This specification covers design, manufacture, assembly, stage inspection, testing before supply of SF6 gas filled 33 KV,630 Amps, outdoor, SCADA compatible Motorized Ring Main Unit with 630 Amps Vacuum Circuit Breaker.

It is not the intent to specify completely herein all details of the design and construction of equipment. However, the equipment shall conform in all respects to high standards of engineering, design and workmanship and shall be capable of performing in continuous commercial operation up to the Bidder's guarantee in a manner acceptable to the Purchaser, who will interpret the meanings of drawings and specification and shall have the power to reject any work or material which, in his judgment, is not in accordance therewith.

The equipment offered shall be complete with all components necessary for their effective and trouble free operation. Such components shall be deemed to be within the scope of Bidder's supply irrespective of whether those are specifically brought out in this specification or not.

The RMU should be fixed type SF-6 insulated with two Load Break Switches and vacuum circuit breakers with O/C & E/F relay for the protection of the transformer. It should be maintenance free equipment, having stainless steel robotically welded enclosure.

The design of the switchgear should be exclusive and specific responsibility of supplier and should be comply with current good engineering practice, the relevant codes and recommendation, the project specific requirements.

2 STANDARDS

The RING MAIN UNIT (RMU) should be designed, manufactured and tested according to the latest version of:

IEC 60694 Common specifications for high-voltage switchgear and control gear standards.
IEC 62271-200 A.C metal-enclosed switchgear and control gear for rated voltages above 1KV and up to and including 72KV and the IEC Codes herein referred.
IEC 62271-102: Alternating current disconnectors (isolators) and earthing switches
IEC 60529 : Classification of degrees of protection provided by enclosures
IEC 60265 High-voltage switches-Part 1: Switches for rated voltages above 1kV and less than 52kV
IEC 60056 : Circuit breakers
IEC 62271-105 High-voltage alternating current switch-fuse combinations IEC 60185 Current transformers
IEC 60186 Voltage transformer
IEC 60255 Electrical relays
Any other codes recognized in the country of origin of equipment might be considered provided that they fully comply with IEC standards.

The design of the switchgear should be based on safety to personnel and equipment during operation and maintenance, reliability of service, ease of maintenance, mechanical protection of equipment, interchangeability of equipment and ready addition of future loads.

3.0 <u>33KV SF6 Insulated Compact Ring Main Unit (RMU)</u>

33 KV SF6 Outdoor, Extensible, Ring Main Unit (RMU), should comprise of 630A Load break switches and 630 A Vacuum "T" OFF Circuit Breaker with (3 O/C & 1 E/F) Relays.

The Load break switch and VCB shall be possible to configure the switchboards as per the site requirements. Maximum four functional units (cable switch/ VCB) can be accommodated in one single tank so as to make it more compact and reliable.

(A). Load break switch (630A)

Load break switch should have the following

1. Manually operated 33KV, 630A Load Break switch shall be a two-positioning Load
2.Break puffer switch using SF-6 gas as an arc quenching medium and separate Earthing Switch with making capacity.
3. "Live Cable" LED Indicators through capacitor voltage dividers mounted on the bushings.
4. Mechanical ON/OFF/EARTH Indication.
5. Anti-reflex operating handle
6. Cable Testing facility inside cable boxes without disconnecting the Cable terminations
7. Cable boxes suitable for 1 X 3C x 300 mm^2 XLPE Cable with right angle Cable Termination Protectors.
8. Cable boxes should be Arc Proof and interlocked with respective Earthing Switches.

For safety of operator it should not be possible to open the cable box unless the earth Switch
is ON.

(B). Circuit Breaker (630A)

Circuit Breaker should have the following:

1 Manually operated 630 Amp Vacuum circuit breaker with auto reclosing duty and rated operating sequence of O – 0.3s - CO - 15s CO.
2. Two position operating mechanism for series downstream disconnector and earth switch.
3. Mechanical ON/OFF/EARTH/SPRING CHAGRE Indication
4. Operation Counter.
5. Integrated operating handle fixed with breaker
6"Live Cable" LED Indicators through Capacitor Voltage Dividers mounted on the bushings.
7.3O/C + 1E/F self-powered relay with Low and High set for Over current and Earth Fault with ring core CT on cables.
8. Cable boxes suitable for 1 X 3C x 300 mm^2 XLPE Cable with right angle Cable Termination protectors
9 .Cable boxes should be Arc Proof and interlocked with respective Earthing Switches.

For safety of operator it should not be possible to open the cable box unless the earth Switch is ON.

4.0 GENERAL TECHNICAL REQUIREMENTS

4.1 DESIGN PARAMETERS

4.1.1 Ring Main Unit, Electrical data

Highest System Voltage	kV	36 kV
Nominal System Voltage	kV	33 kV
Power Frequency Withstand Voltage - Across Disconnector	kV	70 80
Impulse Withstand Voltage - Across Disconnector	kVp	170 195
Rated Frequency	Hz	50
Rated Current Bus bars	A	630
Rated Current (Cable Switch)	A	630
Rated Current (Vacuum Circuit Breaker)	A	630
Breaking Capacities:		
Active Load	A	630
Closed Loop (Cable Switch)	A	630
Off Load Cable Charging (Cable switch)	A	20
Short Circuit Breaking Current (Vacuum Circuit Breaker)	kA	25
Rated Making Capacity	kAp	62.5
Rated Short Time Current	kA	25kA/1-sec

4.1.2 General data, enclosure and dimensions

Standard to which Switchgear complies	**IEC**
Type of Ring Main Unit	Metal Enclosed, Panel type, Compact Module.
Number of phases	3
Whether RMU is type tested	Yes
Whether facility is provided with pressure relief	Yes
Insulating gas	SF6

Nominal operating gas pressure	1.4 bar abs. 20° C
Gas leakage rate / annum %	< 0.1 % per annum
Expected operating lifetime	30 years
Whether facilities provided for gas monitoring	Yes, temperature compensated manometer
Material used in tank construction	Stainless steel sheet, 2 mm Non-Magnetic, Non-ferritic

4.1.3 No Operations, Degree of Protection and Colours

Means of switch operation	separate handle
Means circuit breaker operation	handle and push buttons
Rated operating sequence of Circuit Breaker	O-0.3s - CO 15s - CO
Total opening time of Circuit Breaker	approx. 40-80ms
Closing time of Circuit Breaker	approx. 40-70ms
Mechanical Endurance class of Switch & Circuit Breaker	M1
Electrical Endurance Class: Vacuum Circuit Breaker Load Break Switch Earth Switch	 E1 E3 E2
Principle Switch Disconnector	2 position puffer switch

Degree of protection:

High Voltage live parts,	SF6 tank IP 67
Front cover mechanism	IP 2X
Cable covers	IP 3X
Overall Enclosure	IP 54

Colours:

Front cover	RAL 7035
Side and cable cover	RAL 7035
Enclosure	Dark Admiral Grey

4.2 GENERAL STRUCTURAL AND MECHANICAL CONSTRUCTION

The offered RMU should be of the fully arc proof metal enclosed, free standing, floor mounting, flush fronted type, consisting of modules assembled into one or more

units. Each unit is made of a robotically welded sealed-for life stainless steel tank of thickness not less than 2 mm filled with SF6, containing all high voltage components sealed off from the environment with Ingress protection IP67.The enclosure should meet the "sealed pressure system" criterion in accordance with IEC 62271-200 standard (i.e. a system for which no handling of gas is required throughout the 30 years of service life), with provision of refilling the gas at site if necessary. In addition, manufacturer shall confirm that maximum leakage rate is lower than 0.1% per year. All SF6 enclosures have to pass the leakage test with Helium, before being gas filled with SF6. Due to the characteristics of Helium this test will detect any leakage. The overall design of the switchgear should be such that front access only is required. It should be possible to erect the switchboard against a substation wall, with HV and LV cables being terminated and accessible from the front.

RMU must have a pressure relief device at the bottom of the stainless steel housing to ensure that in the rare case of an internal arc, the high pressure caused by the arc will be released and the hot gases are allowed to be exhausted out at the bottom of the cubicle towards back side to ensure complete safety to the operator. A controlled direction of flow of the hot gas should be achieved.

4.3 DIELECTRIC MEDIUM

SF6 gas shall be used for the dielectric medium for 33KV RMU's in accordance with IEC376. It is preferable to fit an absorption material in the tank to absorb the moisture from the SF6 gas and to regenerate the SF6 gas following arc interruption. The SF6 insulating medium shall be constantly monitored via a temperature compensating gas pressure indicator offering a simple go, no-go indication. Maximum gas pressure shall be 1.4 bars absolute.

4.4 LOAD BREAK SWITCH (630 Amp cable feeder)

It should consist of an SF6 cubicle housing a switch disconnector and an earthing switch. Bus bars and all electrical connections are located inside the tank. The switch positions are closed, open-earthed. The operating shafts for the switches should be have rotary seals where they enter the SF6 cubicle. The operating mechanisms should be located outside on the front of the SF6 tank. Cable bushings should be site-replaceable and located on the front of the SF6 cubicle in a separate cable compartment. Front covers containing the mimic diagram and having a degree of protection IP2XC close the fronts.

4.5 CIRCUIT BREAKERS (630 Amp Transformer feeder)

The 630Amp T-off circuit breaker module should consist of an SF6 cubicle housing a fixed type vacuum circuit breaker and a series disconnector & earthing switch. An integrated relay and related CTs is used for tripping of the circuit breaker. Bus bars and all electrical connections should be located inside the tank. The operating shafts for the switch disconnector should have rotary seals where they enter the SF6 cubicle. The operating mechanisms are located outside on the front of the SF6 tank. Bolted type cable bushings should be site-replaceable and

located on the front of the SF6 cubicle in a separate cable compartment. Front covers containing the mimic diagram having a degree of protection IP2XC seal off the fronts. Vacuum bottles should be used as interrupters of the currents. The make of vacuum bottles should be same as that of RMU. The circuit breaker main circuit should be connected in series with a three-position disconnector earthing switch. The operation between circuit breaker and disconnector earthing must be interlocked. VCB shall use a self-powered relay with low burden trip coil. Relay shall draw the required energy from ring core CTs mounted on cables in the cable compartment.

4.6 EARTHING OF THE MAIN CIRCUIT

Each disconnector/VCB shall be provided with an integral earth switch. Earthing switches should be rated equal to the switchgear rating. Earthing switches should be quick make type capable of making Rated Fault Current. Earthing switch should be operated from the front of the cubicle by means of a removable handle. The earthing switch can be closed only when the disconnector is open. Mechanical interlocking systems shall prevent all operator errors such as closing the earth switch when switch is closed. The HT cables are terminated in the dedicated cable compartment. At the bottom of the cable compartment, an earthing bar system made of copper with a minimum cross section of 120 ^{mm2} should be fitted.

4.7 OPERATING MECHANISMS & INTERLOCKING

All mechanisms should be situated in the mechanism compartment outside the SF6-tank and behind the front covers with degree of protection of IP2X.This gives the opportunity of easy access to all operating mechanisms if retrofit or service should be required. The speed of operation of these mechanisms is independent of how fast the handle is operated. All units shall be equipped with interlocked cable covers. This will prevent access to the cable compartment before earthing switch is in closed position. It will also be impossible to operate switch disconnector to closed position before cable compartment cover is put back in place.

Each switch mechanism is equipped with a padlocking device. When adding a padlock to this device, the access to operate the mechanism will be prevented. This device has three holes with diameter 9 millimeter. All operating mechanisms are equipped with true position indicators for all switches. In order to safeguard true indication, indicators are directly connected to the operating shafts of the switches inside the SF6 tank. Operating handle shall have an anti-reflex system which prevents an immediate re-operation of the switch .In rare case of mechanism failure, it shall be possible to replace the same at site without requiring SF6 gas refilling.

4.7.1 Load Break Switch Mechanism

The mechanism shall have two operating shafts; the upper one for the load break switch and the lower one for the earthing switch. Both shafts are single spring operated and are directly connected to the switches inside the SF6 enclosure.

Due to the mechanical interlock between the upper and the lower operating shaft, it is impossible to operate the load break switch when the earthing switch is in earthed position or to operate the earthing switch when the load break switch is in closed

position.

4.7.2 Breaker Mechanism

This module has two mechanisms; the upper one is for circuit-breaker and the lower one with two operating shafts is for disconnector and earthing switch. The breaker mechanism can be charged by motor or manually by the integrated charging lever. The vacuum circuit-breaker has the possibility of rapid auto-reclosing duty. By means of mechanical push buttons it is possible to close and open the circuit breaker. The opening spring is always charged when the circuit-breaker is in closed position and will be ready to open immediately if the protection relay gives a trip signal. If the mechanism is recharged after closing, it is possible to perform open - close - open sequence. The lower mechanism is identical to the load break switch module. There is a mechanical interlock between these two mechanisms which prevents operation of the disconnector and the earthing switch when the circuit-breaker is in closed position. When the earthing switch is in closed position it is impossible to operate the disconnector, but the circuit-breaker can be closed for testing purposes.

4.8 BUSBARS

Comprising the 3 single phases copper bus bars and the connections to the switch or circuit breaker. The bus bar should be integrated in the cubicle Bus bars should be rated to withstand all dynamic and thermal stresses for the full length of the switchgear.

4.9 FRONT COVERS

Upper and lower front covers shall be manufactured with 2 millimeter Aluzinc and covered with a polycarbonate foil. These foils contain the mimic diagram of the main circuit with the position indicators for the switching devices. Background colour for these foils is grey RAL 7035, which makes the black single line diagram to stand out for easy optical reading of position indicators. Both the upper and lower front covers are removable. The voltage indicators are situated on the front panels.

4.10 POSITION INDICATORS

The position indicators shall be visible through the front cover and must be directly linked to the operating shaft of the switching devices. The operator shall be able to confirm the closing of earth switch. Same can be accomplished either by providing a viewing window for earth switch or by means of true position indication duly type tested as per IEC 62271-102 sub clause A.6.105 to verify proper functioning of position indicating device.

4.11 VOLTAGE INDICATORS

`The voltage indicators are situated on the front cover, one for each module, and indicate the voltage condition of each incoming cable. Identification of the phases is achieved with labels L1, L2 and L3 on the front of the voltage indicators. The voltage indicator satisfies the requirements of IEC61243.

4.12 CABLE COMPARTMENT

It should be possible to terminate up to a 1x 3c x300 sqmm core HV cables in each cable compartment. The cable compartments should be in front and cable entry shall be from bottom. The access to the compartment will be possible by removing the cable cover only when earth switch is ON. Cable Compartments should be Arc Proof and interlocked with respective Earth Switches. Each module has a separate cable compartment that is segregated from each other by means of a partition wall. A partition wall should be fitted to divide the cable compartment from the rear side of the switchgear. In case of an arc inside the tank, followed by the opening of the pressure relief, the partition wall prevents the hot gases flowing out from the pressure relief to enter the cable compartments. All covers are removable. It should be possible to perform cable testing inside the cable boxes without disconnecting the cables.

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4.13 CURRENT TRANSFORMER

All current transformers should be complying with IEC 60185.

Current transformers should be of ring core, dry type, with ratings and ratios as required. Cable current transformers used in circuit breaker modules should be maximum 100mm wide and shall have sufficient VA burden for operation of self-powered relays and low energy trip coil. Current transformers shall be placed in the cable covers so that it can be easily replaced at site without removing the bushings. The CT shall be 5P20 with burden 2.5VA for protection class.

Further characteristics and features of Instrument Transformers used for metering and protection are listed as follows:

Metering Current Transformers:

a) Type: Ring Type
b) Material:, Resin Cast
c) Burden: 30 VA
d) Ratio: 400-200/5 Amps
e) Accuracy Class for metering: 0.5

Protection Current Transformers:

a) Type: Ring Type
b) Material: Resin Cast
c) Burden: 30 VA
d) Ratio: 400-200/5 Amps
e) Accuracy Class for protection: 5P10.

Metering of Potential Transformers:

a) Type: Ring Type
b) Material: Resin Cast
c) Burden: 100 VA
d) Ratio: 33 kV/√3 /110V/√3
e) Accuracy Class for metering: 0.5

4.14 AUXILIARIES

The switchgear should be prepared for options like motor operation, auxiliary contacts and short-circuit indicators. Necessary terminal blocks and wiring etc. should be placed behind the front cover or in LV box of each module.

4.15 FAULT PASSAGE INDICATORS (FPI)

These 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 unit should be self-contained requiring no auxiliary power supply. The Fault passage indicators (FPI) shall facilitate for detection of short circuit fault and earth fault through current transformer inbuilt in Fault Passage Indicators. The FPI shall be integral part of RMU to avoid thefts. The FPI shall have clear display, automatic reset facility and shall be SCADA compatible.

4.16 SCADA Integration

a. PHILOSOPHY

1. It is intent of this project to ensure remote monitoring of electrical supply via suitable SCADA setup. The objectives include:

1. Monitoring and control of all HT Feeders (Substation feeders, ring-feeders and transformer feeders).
2. By monitoring, it means real time availability of following feeder status: ON, OFF, TRIP
3. By control, it means, ' Fail-safe", 'minimum-lag' execution of ON/OFF command with feedback of successful execution or error.

ii. SCADA Integration Unit shall be setup with each Compact Substation to act as an interface between Feedbacks and Signals of CSS and Upper Level SCADA software.

iii. Field Remote Terminal Unit (F-RTU) will be at the heart of this communication architecture, having requisite capability to:

1. Control and Monitor required commands and feedbacks
2. To capture Trafo mains Multifunction Meter data on HV and LV side
3. To establish and maintain communication with upper level SCADA and decided open protocol
4. To allow secured engineering level access to SCADA implementation agency for configuring and establishing the required communication architecture. Necessary software included in scope of supply.
5. To allow secured operator level access to verify SCADA operation and preview web-HMI built into the FRTU (TCP/IP) and take local dumps of datalogs (if applicable).

iv. SCADA Integration Unit will be a segregated and lockable compartment, containing following items:

1. Terminal Blocks and to receive potential free feedbacks from and issue potential free commands to various parts of CSS as per Specific Requirement
2. Suitable Terminal Blocks to act as junction between Mod Bus RTU wiring of 02nos. Multifunction Meters and FRTU
3. Dedicated battery bank with charging arrangement to provide at least 04 -hour backup to various items of SCADA integration unit. Battery sizing calculation to be provided for approval of Engineer-in-charge.

The 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

The battery charger input voltage range shall be from 140V – 230 V AC or a suitable rating Automatic voltage stabilizer shall be installed in the Metering/SCADA cubicle to give rated 230V AC for battery charging.

4. Field Remote Terminal Unit as per specification given below.
5.Light Interface Unit with patch cord to interface FRTU with external armored FO cable.
6.Aux. Items such as:

a. Control Switches: Local/Remote two position switch, Isolation DC MCB, Isolation AC MCB
b. Local Indications: System on Local, System on Remote Communication Error, AC Supply Fail, DC Supply Fail
c. Grounding arrangements: Special and dedicated earthing to be provided for grounding electronic equipment
d. Suitable measures (such as transparent polycarbonate sheet etc.) to prevent accidental contact with terminal blocks during normal operating conditions.
e. Auto cut-off DC LED Lamps of adequate rating to provide required illumination inside the cabinet during night conditions (lamp load to be included in battery sizing calculation)
f. Hinged door with at least 90degree opening span, providing at least IP4X protection during closed door condition.

A Typical List of signals to be integrated with the SCADA Control center is attached

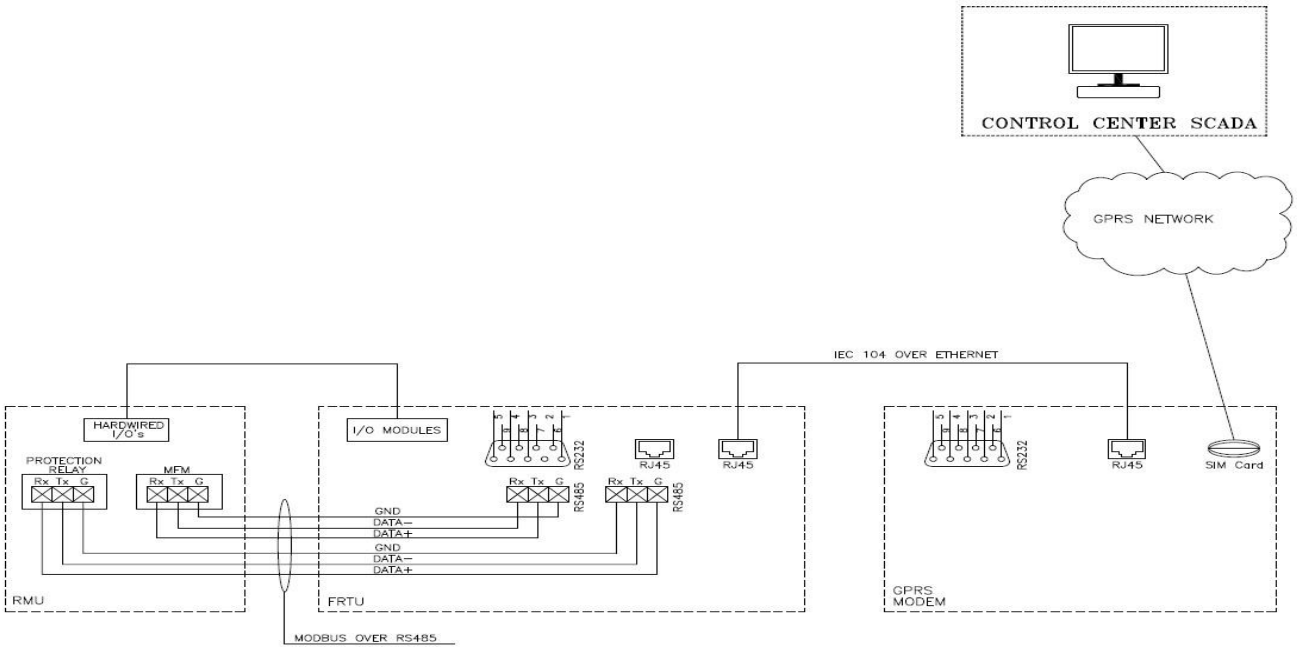
TYPICAL DATA LIST OF 33KV 3WAY RMU

SL. NO.	VOLT. LEVEL	RMU LOCATION	DEVICE IDENTIFICATION	POINT DESCRIPTION	DATA TYPE	SIGNAL TYPE HARD / SOFT
	LBS Module-1					
1	33 KV		LBS	LBS OPEN/CLOSE STATUS	DPS	HARD
2	33 KV		ESW	EARTH SWITCH OPEN/CLOSE STATUS	SPS	HARD
3	33 KV		FPI-SC	FPI S/C	SPS	HARD
4	33 KV		FPI-EF	FPI E/F	SPS	HARD
5	33 KV		VPIS	VOLTAGE PRESENT	SPS	HARD
6	33 KV		SF6	SF6 GAS PRESSURE LOW	SPS	HARD
7	33 KV		LBS-LR	LBS L/R SWITCH IN REMOTE	SPS	HARD
8	33 KV		CAB-COM	CABLE COMPARTMENT DOOR STATUS	SPS	HARD
9	33 KV		MFT	MFT HEALTHY	SPS	SOFT

10	33 KV		KV-RY	VOLTAGE - RY	AI	SOFT
11	33 KV		KV-YB	VOLTAGE - YB	AI	SOFT
12	33 KV		KV-BR	VOLTAGE - BR	AI	SOFT
13	33 KV		AMP-RPH	CURRENT - R-PH	AI	SOFT
14	33 KV		AMP-YPH	CURRENT - Y-PH	AI	SOFT
15	33 KV		AMP-BPH	CURRENT - B-PH	AI	SOFT
16	33 KV		FREQ	FREQUENCY	AI	SOFT
17	33 KV		MW	ACTIVE POWER (P)	AI	SOFT
18	33 KV		MW-RPH	ACTIVE POWER (P) - R-PH	AI	SOFT
19	33 KV		MW-YPH	ACTIVE POWER (P) - Y-PH	AI	SOFT
20	33 KV		MW-BPH	ACTIVE POWER (P) - B-PH	AI	SOFT
21	33 KV		MVAR	REACTIVE POWER (Q)	AI	SOFT
22	33 KV		MVAR-RPH	REACTIVE POWER (Q) - R-PH	AI	SOFT
23	33 KV		MVAR-YPH	REACTIVE POWER (Q) - Y-PH	AI	SOFT
24	33 KV		MVAR-BPH	REACTIVE POWER (Q) - B-PH	AI	SOFT
25	33 KV		MVA	APPARANT POWER (S)	AI	SOFT
26	33 KV		PF	POWER FACTOR	AI	SOFT
27	33 KV		LBS	LBS OPEN/CLOSE COMMAND	DPC	HARD
28	33 KV		FPI	FPI RESET	SPC	HARD
	LBS Module-2					
1	33 KV		LBS	LBS OPEN/CLOSE STATUS	DPS	HARD
2	33 KV		ESW	EARTH SWITCH OPEN/CLOSE STATUS	SPS	HARD
3	33 KV		FPI-SC	FPI S/C	SPS	HARD
4	33 KV		FPI-EF	FPI E/F	SPS	HARD
5	33 KV		VPIS	VOLTAGE PRESENT	SPS	HARD
6	33 KV		LBS-LR	LBS L/R SWITCH IN REMOTE	SPS	HARD
7	33 KV		CAB-COM	CABLE COMPARTMENT DOOR STATUS	SPS	HARD
8	33 KV		MFT	MFT HEALTHY	SPS	SOFT
9	33 KV		KV-RY	VOLTAGE - RY	AI	SOFT
10	33 KV		KV-YB	VOLTAGE - YB	AI	SOFT
11	33 KV		KV-BR	VOLTAGE - BR	AI	SOFT
12	33 KV		AMP-RPH	CURRENT - R-PH	AI	SOFT
13	33 KV		AMP-YPH	CURRENT - Y-PH	AI	SOFT
14	33 KV		AMP-BPH	CURRENT - B-PH	AI	SOFT
15	33 KV		FREQ	FREQUENCY	AI	SOFT
16	33 KV		MW	ACTIVE POWER (P)	AI	SOFT
17	33 KV		MW-RPH	ACTIVE POWER (P) - R-PH	AI	SOFT
18	33 KV		MW-YPH	ACTIVE POWER (P) - Y-PH	AI	SOFT
19	33 KV		MW-BPH	ACTIVE POWER (P) - B-PH	AI	SOFT
20	33 KV		MVAR	REACTIVE POWER (Q)	AI	SOFT
21	33 KV		MVAR-RPH	REACTIVE POWER (Q) - R-PH	AI	SOFT
22	33 KV		MVAR-YPH	REACTIVE POWER (Q) - Y-PH	AI	SOFT
23	33 KV		MVAR-BPH	REACTIVE POWER (Q) - B-PH	AI	SOFT
24	33 KV		MVA	APPARANT POWER (S)	AI	SOFT
25	33 KV		PF	POWER FACTOR	AI	SOFT
26	33 KV		LBS	LBS OPEN/CLOSE COMMAND	DPC	HARD

27	33 KV		FPI	FPI RESET	SPC	HARD
	CB Module-1					
1	33 KV		CB	CB OPEN/CLOSE STATUS	DPS	HARD
2	33 KV		ESW	EARTH SWITCH OPEN/CLOSE STATUS	SPS	HARD
3	33 KV		VPIS	VOLTAGE PRESENT	SPS	HARD
4	33 KV		SPCH	SPRING CHARGE	SPS	HARD
5	33 KV		CAB-COM	CABLE COMPARTMENT DOOR STATUS	SPS	HARD
6	11 KV		RMU-DSW	RMU PANEL DOOR SWITCH STATUS	SPS	HARD
7	33 KV		OCEF-OPTD	O/C & E/F OPERATED	SPS	HARD
8	33 KV		CB-LR	CB L/R SWITCH IN REMOTE	SPS	HARD
9	33 KV		OC-OPTD	O/C OPERATED	SPS	SOFT
10	33 KV		EF-OPTD	E/F OPERATED	SPS	SOFT
11	33 KV		CB	CB OPEN/CLOSE COMMAND	DPC	HARD
12	33 KV		PRTN-RESET	PROTECTION RELAY RESET	SPC	SOFT
	COMMON					
1	AUX		24V DC-FAIL	24V DC FAIL ALARM	SPS	HARD
2	AUX		BCHG AC-FAIL	BATTERY CHARGER AC FAIL ALARM	SPS	HARD
3	AUX		BCHG-FAIL	BATTERY CHARGER FAIL	SPS	HARD

General Architecture diagram for RMU SCADA Integration



b. **FIELD REMOTE TERMINAL UNIT**

i The RTU system shall be responsible to collect process information and control the substation equipment via different communication protocols described in this specification. The unit consist of a compact solution all required communication units like CPU, multi-I/O Modules and power supply in a single scalable DIN-Rail housing.

ii. The assembling of the RTU should be available in centralized architecture or in a de-centralized way with remote I/Os distributed Modules.

iii. The equipment shall have front access to indicate operational and error states by light emitting diodes on the front plate. The electronic modules shall be labelled in the front using the same name as indicated in the technical documentation.

iv. The equipment shall be designed to restart automatically after power failure. It shall not be necessary to manually restart the equipment after the recovery of the auxiliary power source.

v. Hardware Design

1. The RTU shall be microprocessor-based and shall be covered inside DIN rail mountable modules or in scalable housings. The CPU board will be responsible for the main processing tasks and for the communication incl. Reading/Writing process events /commands from the I/O boards, Communication to control center and to subordinated devices Managing of the time base and synchronizing the I/O boards. Each CPU board shall have a 32-bit main processor.

The RTU shall be capable of handling more than 2000 data points, with CPU equipped with at least 400 Hz Processor, 256 MB RAM, 256 MB storage and 8 MB flash /Prom memory. Programs and configurations shall not require reloading due to power outage. It must be possible to easily change or update the firmware to implement enhancements or change protocols.

2. The CPU board should have 2 to 4 serial ports (RS485/RS232- C) which can be configured separately with multi protocols. Each CPU board shall be equipped with up to 2 Ethernet interface for the download of configuration / firmware files from a local or remote computer. It shall also be possible to transfer the configuration of an RTU to a local or remote computer. With the Ethernet interface it shall also be possible to perform a remote diagnostic of the RTU and Ethernet based communication to higher and lower equipment.

vi. The RTU DIN-Rail shall provide Data Archives in order to save data like system events from the RTU, process events, measuring values,
pulse counter values. with the time-stamp with 1 ms resolution in the data archive which will be saved power-fail-save in the Flash/E-Prom memory of the RTU and shall be locally and remotely accessible.

vii. The central processor shall include a real time clock with the possibility to be synchronized by external GPS equipment or from the operation control center via a periodically transmitted synchronization instruction with a communication protocol supporting this function.

viii. Each I/O device shall be equipped with its own microprocessor which takes over a part of the data processing, e. g. digital filter for binary inputs, threshold supervision for analog inputs, etc. and shall also have their own times which are synchronized by the CPUs periodically via the I/O bus, in order to provide time stamping of events and analog values with an accuracy of +/-1ms within the RTU.

ix. The inputs shall be potentially isolated by the means of optical couplers. Direct connection to the input and output process signals voltages are available with 24..60VDC and 110..125VDC nominal voltages without the need of interposing components.

x. The RTU DIN-Rail main power supply is nominal 24VDC.With basic features such as potential isolation between inputs and outputs, cooling by natural convection, short-circuit proof, over voltage protection, controlled load balancing, alarm indication in case of failure.
There shall be a minimum of 20% spare capacity of I/O signals available on each FRTU for the purpose of future expansion.

xi. **Functional Requirement**

1. Communication with Control Centers

a. The RTU DIN-Rail must be capable of communicating with a Master Station using the tele-control communication protocol IEC 60870-5-104 over TCP/IP. It must be possible to communicate simultaneously with multiple Master Stations as a communication Gateway Interface, using different communication protocols (e.g serial communication via RS232 and or RS485 standard ports, and min. one 10/100 Base T port for Ethernet communication) All communication interfaces shall be accessible on the front side provided as RJ45 jacks integrated in the board`s front plate.

2. Communication at Station Level - IEC61850

a. If required, the RTU DIN-Rail shall support the communication via IEC61850 station bus. The RTU shall provide IEC61850 client and server functionality.

3. Communication with IEDs

a. The RTU DIN-Rail shall also provide serial / Ethernet interfaces for the communication with subordinated devices like intelligent electronic devices (IEDs). Digital protection relays, metering devices or subordinated RTUs shall be connectable. Communication should be possible over IEC 60870-5-101, IEC 60870-5-103, DNP 3 level 2, Modbus. etc.

4. Communication via GPRS Modem

a. The RTU DIN-Rail provider optionally support an integrated 4G-Modem in their RTU DIN-Rail solution. A radio interface via an integrated 4G Modem and pluggable 4G SIM Card is necessary. The connection to an external antenna is also part of the option.

xii. Time Management and Synchronization

1. The internal time management shall be controlled by the CPU communication board. The time resolution of the RTU DIN-Rail shall be 1 ms for events, scanned by the directly connected I/O board.

2. Synchronization with absolute time should be possible by Time synchronization of the RTU DIN-Rail by the network control Centre (NCC) via a periodically transmitted synchronization instruction with a communication protocol supporting this function, or Time synchronization of the RTU DIN-Rail using SNTP V4 (RFC2030) on a LAN/WAN network.

3. If required, a time synchronized RTU DIN-Rail shall be able to synchronize subordinate RTUs and IEDs via a periodically transmitted synchronization instruction with a communication protocol supporting this function.

xiii Archive Function

1. The RTU DIN-Rail shall be able to handle archive data and shall be protected against voltage loss.
2. RTU should be able to handle following data with time stamp:
   a). Process events of the RTU and connected subsystems(subordinate RTU'S,IED's,

protection relays),if applicable
b). Virtual data points
c). User-login
d). Commands
e). System events and messages
f). Analogue measured values
g). Integrated totals (counter values) etc.

3. The file archive should be able to handle Disturbance recorder files, Load profiles of connected metering devices (e.g. IEC62056-21), disturbance recorder of connected subordinated RTUs with IED's etc.
4. Upload to a flash memory shall be possible.
5. Sequence of Events (SOE):
Time Resolution - 10 ms minimum
Buffer Size – 10,000 events minimum

xiv. Diagnostics

1. All RTU modules, at minimum all Input modules, shall have light emitting diodes (LEDs) to indicate errors or operating modes.
2. The application data shall be stored on Compact Flash Cards which makes it possible to exchange modules without new configuration download.
3. The functional operation of the RTU DIN-Rail shall be guaranteed by a comprehensive monitoring concept. The hardware and software shall be continuously monitored from the I/O modules throughout the entire RTU DIN-Rail.
4. The RTU DIN-Rail shall report its system and error states to the Control Center by means of System Events
5. The RTU DIN-Rail shall provide remote diagnostics capabilities, e.g. by means of a Web-Server via LAN/WAN.

xv. Security

1. The following security functions shall be included in the RTU:
User Account Management (UAM), integrated in the Webserver User Activity Logging (UAL) on the CompactFlash® of the CMU Closing of unused TCP/IP ports Enabling/disabling of Webserver use individually per CMU.
All the above security features fulfill basic requirements ofthe following security standards: NERC/CIP, North American Electric Reliability Corporation - Critical Infrastructure Protection, IEC 62351, IEEE 1686 etc.

xvi. Tools

1. Configuration tool
a. The supplier shall provide a suitable software tool for the configuration and database programming of the RTU DIN-Rails. The tool shall be state-of-the-art, running on standard desktop or laptop computers, and shall be based on Windows. All related RTU DIN-Rail software must be HW independent and not related to the different type or architecture of the RTU DIN-Rails.
b. The user interface shall be an application according to Microsoft standard presentation format.
c. The configuration tool shall contain an online documentation for easy handling.
d. It also shall provide an Excel import data interface that enables the user to use Excel sheets to manage RTU configuration data and processing parameters.

RTU design should be type-tested for adequate performance as per following details:

Item	Standard	Test Level
1	Insulation resistance according IEC 60255-5	>100MOhm / 500V DC
2	Insulation dielectric withstand voltages according IEC 60255-5 (IEC 60870-2-1 class VW3, ANSI/IEEE C37.90-1989, 1,5kV)	2,5kV, 50Hz, 1min
3	Insulation impulse voltage	

Item	Standard	Test Level
1	Low Temperature (IEC 60068-2-1)	-25°C
2	High Temperature (IEC 60068-2-2)	+70°C
3	Temperature-Humidity (IEC 60068-2-30, cyclic test)	95%
4	Vibration response test, sinusoidal: IEC 60068-2-6 IEC 60255-21-1 Class 1 0,5g (10 Hz)	0,5g (10 150

xviii. Safety, Insulation, EMC Immunity and CE Declaration

1. The RTU should be tested according safety standard IEC

Item	Standard	Test Level
1	Electro static discharge immunity (IEC 61000-4-2 level4) (IEC61000-6-2 8/6 KV) (IEC60255-22-2 8/6 KV) (ANSI/IEEE C37.90.3-2001,8KV)	Cubicle:15/ 8kV Modules: 8/6kV
2	Radiated Electromagnetic Field (IEC 61000-4-3) (IEC 60870-2-1-A 5.1 level 3) (IEC 61000-6-2 10 V/m) (IEC 60255-22-310 V/m)	10 V/m Level 3

3	Electrical Disturbances 1 MHz Burst IEC 60255-22-1 IEC61000-4 IEC61000-18	2.5KV CM, 1.0KV DM
4	Fast Transient Burst Immunity IEC 61000-4-4 (IEC 60870-2-1 A2.3 level 4) (IEC61000-6-2 A/D=2kV, S=1kV) (IEC 60255-22-4 4kV) (ANSI/IEEE C37.90.1-2002, 4kV)	4kV Level 4
5	Surge Immunity IEC 61000-4-5 (IEC 60870-2-1 A2.2 level 3) (IEC61000-6-2 A=1/2kV, S=1kV) (IEC 60255-22-3 2kV	2kV Class 3
6	Feeder Distributed RTU IEC 61000-4-5 (IEC 60870-2-1 A2.2 level 4) (IEC61000-6-2 A=1/2kV, S=1kV) (IEC 60255-22-3 2kV)	4 kV Class 4
7	Conducted RF Disturbance Immunity IEC 61000-4-6 IEC61000-6-2 10V) (IEC 60255-22-6 10V)	10 V Level 3
8	Pulse Magnetic Field Immunity IEC 61000-4.9	1000A Level 5

EMC Emission Tests

Item	Standard	Test Level
1	Enclosure: Radio Interference Field Strength IEC/CISPR 11 /EN50011	30dB (30 30MHz) 37dB (230 1000MHz)
2	Power Supply : Radio Interference Voltage IEC/CISPR 11 /EN50011	79dB (0,15- 0,5MHz) 79dB (0,5-30MHz)

5.0 MANUFACTURING FACILITY

The manufacturer shall ensure workmanship of high quality. There shall be adequate machinery tools and tackles such that the product shall meet the internationally accepted standards. Facility should be certified for ISO 9001, 14001 and OHSAS 18001.The manufacturing facility shall be equipped with the following:

1. Robotic welding station for stainless steel main tank, ensuring a leak rate of less than 0.1% per year.

2. Work benches with pneumatic adjustable work benches and torques wrenches, giving flexibility to workmen for proper tightness of internal components of sealed tank.
3. State of the art fully automatic gas filling and leakage testing machine for ensuring the quality of sealing and have precision to measure leak rate less than 0.1% per year.
4. High voltage testing station to have high voltage power frequency test and partial discharge measurement.
5. Computerized system to measure time travel characteristic of breaker before sealing the tank.

6.0 TESTING AND CERTIFICATION

6.1 Type Tests

Units should be type tested in accordance with IEC standards 60056, 62271-102, 60265, 62271-200, 62271-105,60529 and 60694. The following type tests have been performed and available if required

1. Short time and peak withstand current test.
2. Temperature rise test.
3. Dielectric tests.
4. Test of apparatus i.e. circuit breaker and earthing switch
5. Arc fault test.
6. Measurement of resistance of main circuit.
7. Mechanical endurance test.
8. Duty cycle test.
9. Internal arc test for HT chamber.
10. Degree of protection for IP 54 for Outdoor enclosure.
11. Tests to verify true position indication devices as per IEC 62271-102.

6.2 Routine tests

Routine tests should be carried out in accordance with IEC 62271-200 standards. These tests should be ensure the reliability of the unit.
Below listed test should be performed as routine tests before the delivery of units:

1. Withstand voltage at power frequency.
2. Measurement of the resistance of the main circuit Partial discharge test for the tank.
3. Withstand voltage on the auxiliary circuit.
4. Operation of functional locks, interlocks, signaling devices and auxiliary devices.
5. Suitability and correct operation of protections, control instruments and electrical connections of the circuit breaker operating mechanism.
6. Verification of wiring.
7. Visual inspection.
8. Time travel characteristics measurement facility for Breaker should be available with the manufacturer to assess the quality of RMU.

7.0 DOCUMENTATION

An instruction manual should be provided with necessary information for receiving, handling, storage, installation, operation and maintenance.

Routine test certificate should be follow each unit and standard schematic drawings should be delivered for Ring Main Units. Compact Switchgear should have drawings that consist of system single line drawings, general arrangement and schematic drawings for order specific units. All drawings shall confirm to International Standards Organization (ISO) "A" series of drawing sheets/Indian Standards Specification IS : 11065. All dimensions and data shall be in ink and suitable for microfilming. All dimensions and data shall be in S.I. Units.

1 List of drawings and Documents

The bidder shall furnish four sets of relevant descriptive and illustrative published literature, pamphlets and the drawings for preliminary study along with offer.

1. General outline drawings showing dimensions and shipping weights, quantity of Insulating media.\
2. Sectional views showing the general constructional features of the circuit breaker
3. Including operating mechanism, arcing chambers, and contacts with lifting dimensions for maintenance.
4. Drawings showing control cabinets and circuit diagrams for operating mechanism.
5. Schematic diagrams of breaker offered for control and supervision.
6. Structural drawings for support structures.
7. Foundation plan and loading data and foundation design.
8. Drawings showing the complete operation cycle of the Ring Main Unit with description.
9. Soft copies(Auto CAD & PDF Versions of all the drawings shall be submitted by the successful bidder.

8.0 NAME PLATE :

Each main RMU and it associated equipment's shall be provided with a name plate legible and indelibly marked with at least the following information .

1. Name of Manufacturer.
2. Type
3. Serial No.
4. Voltage.
5. Current.
6. Frequency.
7. Symmetrical breaking Capacity.
8. Making Capacity.
9. Short time current and Its duration.
10. Purchase Order No. and Date,
11. Month and Year of Supply.
12. Rated Lighting Impulse withstand voltage.

9.0 CHALLENGE CLAUSE:

The Purchaser reserves the right to have the material, received after inspection by the authorized inspecting officer, again tested for any parameter(s) from approved/NABL accredited testing house/in house technique of the purchaser. The results if found deviating/unacceptable or in non-compliance with the approved GTP'S, the lot shall be rejected and bidder shall arrange to replace the rejected lot within thirty (30) days of such detection at his cost including to & fro transportation.

10.0 **GUARANTEED TECHNICAL PARTICULARS**:

The bidder should fill up the details in schedule A – "Guaranteed Technical Particulars" and the statement such as "as per drawing enclosed", "as per KPDCL requirement", "as per IS", "as per specification" etc. shall be considered as details not furnished and such offers will be rejected.

Schedule A

GENERAL TECHNICAL PARTICULARS - 33kV RMU

Sl. No.	Descriptions	Details
1.0	RMU Category	
2.0	RMU application	Outdoor
3.0	Dielectric medium	SF6
4.0	Interrupting medium	SF6 for Load Break Switch
5.0	System Frequency	50 Hz
6.0	Rated Voltage	36 KV
7.0	Service Voltage	33 KV
8.0	Rated current -Line Switches	630 A
9.0	Rated Current-CB	630 A for all type
10.0	Rated Short time current withstand (1 sec)	20 KA for 3 sec
11.0	Rated Short time Making capacity	62.5 KA
12.0	Rated cable charging interrupting current incomer load break switch	25 A
13.0	Rated load interrupting line current	630 A
14.0	Rated cable charging interrupting current incomer load break switch	25 A
15.0	No. of operations at rated short circuit current online switches earthing switches and CB	5 Close
16.0	Opening time of breaker (max.)	40-60 m sec
17.0	Closing time of breaker (max)	40-60 m sec
18.0	i. Mechanical endurance for Isolator & Earth Switch	1000
	ii. Mechanical endurance for Circuit Breaker	2000
19.0	Electrical operations of Isolator & E/Switch at rated current	100
20.0	Temp rise above ambient	55 C over an ambient of 50□C
21.0	Min Gas pressure	1.3 Bar
22.0	SF6 Gas pressure indicator (SCADA compatible)	Yes
23.0	Guaranteed SF6 leakage per annum	Less than 0.1%.
24.0	Degree of protection	IP 67 for the tank, IP 2X for the front, IP 55 for Outdoor
25.0	Internal Arc test	IAC AFLR 20kA for 1 sec
26.0	Lightning Impulse withstand Voltage	170 kVp
27.0	Power Frequency withstand voltage	70 kV RMS

28.0	SF6 Tank design	Robotically sealed unpainted stainless-steel enclosure with SF6 Gas. Sealed pressure system by robotic welding so that no refilling of gas is required for 30 years. No gas work at site. Complete body shall be tamperproof to prevent access to live parts. No gaskets shall be used. No bolts shall be provided. HT bushings site replaceable
29.0	Earth bus bars	To be provided by bidder
30.0	Material & size	Copper - 120 sq.mm
31.0	Incomer Load Break switch: Shall be SF6 type with least maintenance. Shall have at least 3 positions, Open, Close & earth with natural interlocks.	To be provided by bidder
32.0	Circuit Breakers: Preferably SF6 type with minimum maintenance and shall have at least 2 positions I.e. Open & Close, Manual operation	To be provided by bidder
33.0	Make of Relay	
34.0	Cable Clamps	To be provided by bidder
35.0	Cable termination	To be provided by bidder
36.0	Size	Suitable
37.0	Earth fault passage Indicator One per RMU	To be provided by bidder
38.0	Operating handle	To be provided by bidder
39.0	Bus bar Material	Copper
40.0	SCADA Compatibility -	To be provided by bidder
41.0	Moisture absorption material	Silica gel
42.0	**CURRENT TRANSFORMER**	
42.1	Make	
42.2	Type & voltage level	Low Voltage
42.3	Reference Standard	IEC 298
42.4	CT ratio as specified	Yes
42.5	Rated frequency	50
42.6	Short circuit withstand	
a)	Short time current for 3 Sec. (kA rms)	21
b)	Short time current for 5 Sec. (kA rms)	NA
c)	Dynamic current (kA peak)	52.5
42.7	Class of insulation	AS PER IEC
42.8	Temperature rise over ambient 0C	AS PER IEC
42.9	Basic insulation level	LT CT
42.10	For Tripping	
a)	CT Ratio	CT Ratio – 400-200/5A

b)	Class of Accuracy	Class 5P10 for protection
		Class 0.5 for Metering
c)	Rated burden VA	Burden 30 VA
43.0	Auxiliary PT for Battery and Battery Charger	Auxiliary Potential Transformer 33kV/√3 //110V/√3 with 500 VA burden for 230V AC supply. HRC fuses shall be provided on the HV side
	BUS PT for Metering	33kV/√3 // 110V, 100 VA, HRC fuses shall be provided on the HV side
	Insulation Material in PTs	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

(**To be filled by the bidder**)

GENERAL TECHNICAL PARTICULARS - 33kV RMU

Sl. No.	Descriptions	Details
1.0	RMU Category	
2.0	RMU application	
3.0	Dielectric medium	
4.0	Interrupting medium	
5.0	System Frequency	
6.0	Rated Voltage	
7.0	Service Voltage	
8.0	Rated current -Line Switches	
9.0	Rated Current-CB	
10.0	Rated Short time current withstand (1 sec)	
11.0	Rated Short time Making capacity	
12.0	Rated cable charging interrupting current incomer load break switch	
13.0	Rated load interrupting line current	
14.0	Rated cable charging interrupting current incomer load break switch	
15.0	No. of operations at rated short circuit current online switches earthing switches and CB	
16.0	Opening time of breaker (max.)	
17.0	Closing time of breaker (max)	
18.0	i. Mechanical endurance for Isolator & Earth Switch	
	ii. Mechanical endurance for Circuit Breaker	
19.0	Electrical operations of Isolator & E/Switch at rated current	
20.0	Temp rise above ambient	
21.0	Min Gas pressure	
22.0	SF6 Gas pressure indicator (SCADA compatible)	
23.0	Guaranteed SF6 leakage per annum	
24.0	Degree of protection	
25.0	Internal Arc test	
26.0	Lightning Impulse withstand Voltage	
27.0	Power Frequency withstand voltage	
28.0	SF6 Tank design	

29.0	Earth bus bars	
30.0	Material & size	
31.0	Incomer Load Break switch: Shall be SF6 type with least maintenance. Shall have at least 3 positions, Open, Close & earth with natural interlocks.	
32.0	Circuit Breakers: Preferably SF6 type with minimum maintenance and shall have at least 2 positions I.e. Open & Close, Manual operation	
33.0	Make of Relay	
34.0	Cable Clamps	
35.0	Cable termination	
36.0	Size	
37.0	Earth fault passage Indicator One per RMU	
38.0	Operating handle	
39.0	Bus bar Material	
40.0	SCADA Compatibility -	
41.0	Moisture absorption material	
42.0	**CURRENT TRANSFORMER**	
42.1	Make	
42.2	Type & voltage level	
42.3	Reference Standard	IEC 298
42.4	CT ratio as specified	
42.5	Rated frequency	
42.6	Short circuit withstand	
a)	Short time current for 3 Sec. (kA rms)	
b)	Short time current for 5 Sec. (kA rms)	
c)	Dynamic current (kA peak)	
42.7	Class of insulation	AS PER IEC
42.8	Temperature rise over ambient 0C	AS PER IEC
42.9	Basic insulation level	
42.10	For Tripping	
a)	CT Ratio	
b)	Class of Accuracy	
c)	Rated burden VA	
43.0	Auxiliary PT for Battery and Battery Charger	
	BUS PT for Metering	
	Insulation Material in PTs	

Signature of the tenderer: _____

Name: _____

Designation: _____