WEST BENGAL STATE ELECTRICITY DISTRIBUTION COMPANY LIMITED (A Govt. Of West Bengal Enterprise)

Office of the Chief Engineer, Procurement & Contracts
Departments Vidyut Bhavan, 4th. Floor, B-Block. Bidhannagar,
Salt lake City, Kolkata-700 091

TECHNICAL SPECIFICATIONS FOR 1000 KVA, 11/0.415 KV PACAKAGE TYPE SUB-STATION (PSS)/CONTAINER TYPE SUB-STATION (CSS)

1.0.0 SCOPE :

This specification covers Design, Engineering, Manufacture, Assembly, testing, Inspection, packing , delivery at plinth at site in case of procurement and in case of turn key execution this also includes Erection, Testing & Commissioning of Package Type Sub-station/Container Type Sub-station at site with 3 Way SF_6 Insulated SCADA Compatible RMU , 1000 KVA 11/0.415 kV Distribution Transformer & LT Panel with 1 IN+10 OUT Configuration along with all inter-connections

1.1.0 3 Way SF_6 Insulated SCADA Compatible RMU & 1000 KVA 11/0.415 kV Distribution Transformer to be supplied as per the latest Technical Specification of WBSEDCL.

1.2.0 All equipments and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standard / IEC standard.

1.3.0 The electrical installation shall meet the requirement of Indian Electricity Rules as amended up to date relevant IS code of practice and Indian electricity act.

1.4.0 The Unitized Sub-station offered shall in general comply with the latest issues including amendments of the following standards.

2.0.0 CLIMATIC CONDITIONS :

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

- Maximum ambient air temperature: + 50 °C
- Minimum ambient air temperature: +4 °C
- Max. daily average temperature : +45 °C
- Maximum relative humidity: 95 %
- Average thunder storm days per annum: 200
- Average rainfall per annum: 2000mm
- Maximum wind pressure & wind speed: 150Kg/sq.m & 50m/sec
- Altitude above mean sea level: 1000 m
- Pollution level according to IEC 60815: Level III (Heavy)
- Location: Any part of West Bengal

The equipment offered shall be suitable for continuous satisfactory operation in Tropical area of Installation.

3.0.0 TECHNICAL QUALIFICATION REQUIREMENT:

1) The Bidder should be manufacturer of 11/0.415 KV or higher class CSS/PSS & the manufacturer of any one of the major component of CSS/PSS namely HT RMU or Cast Resin Dry Type Transformer.

i) The Bidder must have at least 03 (three) years experience in supplying similar or higher KV Class CSS/PSS in different power utilities in India

ii) The bidder must have designed, supplied & commissioned at least 10 nos. of similar or higher KV class CSS/PSS in different power utilities in India during last 5 (five) years & which are under minimum 01 (one) year satisfactory operation from the date of tender opening

iii) The Bidder should have fully equipped technical office in India for technical support after sale.

iv) The Bidder should offer type tested CSS/PSS of similar KV Class. Type test certificate carried out in NABL accredited laboratory or Govt. laboratory during last 5 (five) years from the date of tender opening shall only be acceptable and to be submitted along with the bid.

v) The Bidder should submit history of past supply, client's certificate in support of satisfactory operation of similar or higher KV clss CSS/PSS

Personnel Capability: The Bidder must have full-fledged set up to be deployed during execution shall be furnished along with the offer(For Tuen Key Execution only)

Financial Qualification Requirement: The Bidder shall have to comply necessary financial requirements according to purchase policy of WBSEDCL.

Guarantee Clause: 5 years from the date of supply. The manufacturers of CSS/PSS is to provide guarantee for the items not manufactured by them but to be included in total supply of CSS/PSS.

4.0.0 <u>DESIGN CRITERIA :</u>

4.1.0 Compact Sub-station shall consist of **11KV SF6 Insulated 3 Way SCADA Compatible RMU with Vacuum Circuit Breaker as protection to transformer ,Resin Cast Dry Type Transformer & L.T. Switchgear** with all connection accessories, fitting & auxiliary equipment in a pre-fabricated Enclosure. The complete unit shall be installed on a substation plinth (base) as **Outdoor**

substation. 11KV Load Break Cable Switches control incoming-outgoing feeder cables of the 11KV ring distribution system. The Vacuum Circuit Breaker shall be used to control and isolate the 11kV/415V Distribution transformer. The transformer's L.T. side shall be connected to L.T. switchgear by means of Aluminum Bus bar. The connection cables to consumer shall be taken out from the L.T. switchgear.

4.2.0 The Switchgear and component thereof shall be capable of withstanding the mechanical and thermal stresses of short circuit listed in ratings and requirements clause without any damage or deterioration of the materials.

4.3.0 For continuous operation at specified ratings temperature rise of the various switchgear components shall be limited to permissible values stipulated in the relevant standard and / or this specification.

4.4.0 The Enclosure consisting of High Voltage switchgear-control gear, Low Voltage switchgear-control gear & Transformer of the Unitized substation shall be designed to be used under **normal outdoor service condition**. The enclosure should take minimum space for the installation including the space required for approaching various doors & equipment inside. The enclosure construction shall be such that it fully protects ingress of rain water, dust & rusting.

4.5.0 The main components of a prefabricated-unitized substation are Transformer, High-Voltage switchgear-control gear, Low-voltage switchgear-control gear, corresponding Interconnections (cable, bus bars) & auxiliary equipment. The components shall be compartmentalized in the enclosure. All the Components shall comply with their relevant IS/IEC standards.

5.0.0 APPLICABLE STANDARDS

Standard	Description
IEC 60529	Classification of degrees of protection provided by enclosures of electrical equipment
IEC 60298	A.C metal-enclosed switchgear and control gear for rated voltages above 1KV and up to and including 72KV
IEC 1330	High voltage/Low voltage prefabricated substations
IEC 60694	Common specification for HV switchgear standards
IEC 60265	High-voltage switches-Part 1: Switches for rated voltages above 1kV and less than 52 kV
IEC 60801	Monitoring and control
IEC 60185	Current Transformers
IEC 60186	Voltage transformers
BS 159	Busbar
IEC 60137	Bushings
CP 1013(British Code of Practice)	Earthing

Standard	Description
IEC 60255	Specification for Static Protective Relays
BS 6231	Wires and wiring
IEC 61000	Electromagnetic compatibility
IEC 60129	Alternating current Disconnector (isolators) and earthing switches
IEC 62271-200	Metal enclosed BS 5311 switchgear
IEC 62271-100	MV AC circuit breaker
IEC 60060-1 BS 923	High Voltage test technique
IEC 60034-1	Motors
IEC 60947-4-1	Control Gears
IEC 60623	Open Ni-Cd prismatic rechargeable cell
IEC 376	Filling of SF6 gas in RMU
IS: 10118	Code of Practice for selection, installation & maintenance of switchgear
IS:11171	Dry Type Distribution Transformer
IEC-439-1	Low voltage switch gear & control gear assemblies Part-I, type tested & partially type tested assemblies
IEC-947-1	Low voltage switch gear & control gear Part-I, general rules
IEC-1180-1	High voltage test techniques for low voltage equipment Part-I definition test & procedure requirement
IEC-529	Degree of protection provided by enclosures (IP Code)

6.0.0 OUTDOOR ENCLOSURE:

6.1.0 The Enclosure shall be made of Galvanized Sheet Steel/Powder Coated CRCA tropicalised to meet Indian weather conditions including all the partition sheets & doors except base of the enclosure.

. The Thickness of those enclosure shall be 1.50 mm.(Minimum) for non-load bearing members and 2 mm(Minimum) for load bearing members. The Enclosure shall be such that if required any of the equipments inside the CSS can be replaced without any hassles i.e without causing damage to the CSS itself or any other equipments. The paint shall be Powder coated paint as per colour code as per IS 632

6.2.0 The base of the enclosure shall be of 4.0 mm thickness Hot Dip Galvanized Sheet Steel /Powder Coated CRCA with ISMC(Indian Standard Medium Channel) with 100X50X4 mm thickness with Powder coated paint as per colour code as per IS 632. The entire Package Substation shall be Factory Assembled & Factory Fitted.

6.3.0 The structure of the substation shall be capable of supporting the gross weight of all the equipments & the roof of the substation compartment shall be designed

to support adequate loads. In case of relocation of the Package Substation, the entire substation should be capable of getting lifted and placed as a Single Unit without dismantling of any of the major equipments inside. The lifting arrangement should be from the bottom of the enclosure & not from the top.

6.4.0 There shall be proper / adequate ventilation inside the enclosure so that hot air inside transformer compartment enclosure are directed out by help of duct. Louvers apertures shall be provided so that there is circulation of natural air inside the enclosure. This is applicable for transformer compartment only. The Package Substation should be designed & engineering to have natural cooling & ventilation instead of forced cooling / ventilation.

6.5.0 The complete design shall be compartmentalized.

6.6.0 The protection degree of the Enclosure for Transformer shall be IP 23 and . for HT and LT switchgear enclosure the protection degree shall be IP 54. Roof should be slant to avoid any type of water logging. The roof should be "Double roof type" for better heat dissipation from Transformer compartment and also be detachable type (openable only from inside).

6.7.0 Separate lockable double leaf doors should be provided for HT & LT chambers. The transformer enclosure should have double leaf door at one side and with door and bolted cover on other side for taking in/out the transformer unit. The other side of this compartment should have bolted covers. All doors & bolted covers shall be provided with proper interlocking arrangement for safety of operator. The doors should have additional external padlocking arrangement to prevent unauthorized entry.

6.8.0 **Interconnection:** The connection of HT switchgear to Transformer shall be with the help of suitable size of cables from Transformer to LT switchgear with the help of suitable size of Aluminum bursars.

6.9.0 **Internal Fault**: Failure within the unitized substation due either to a defect, an exceptional service condition or mal-operation may initiate an internal arc. Such an event may lead to the risk of injury, if persons are present. The unit shall be tested for Internal Arc fault test for 20 KA for 1 second as per IEC: 62271-202 with amendment up to date. The Unit shall be tested for internal Arc fault test for 20 KA for 1 Sec for Class A (PS A) category.

6.10.0 **Covers & Doors**: Covers & doors are part of the enclosure. When they are closed, they shall provide the degree of protection specified for the enclosure. All covers, doors or roof shall be provided with locking facility or it shall not be possible to open or remove them before doors used for normal operation have been opened. The doors shall open outward at an angle of at least 90 degrees & be equipped with a device able to maintain them in an open position. Proper padlocking facility shall be provided for doors of each compartment. Transformer compartment doors must be opened from both the sides & should not have access from outside.

6.11.0 **Earthing**: All metallic components shall be earthed to a common earthing point. It shall be terminated by an adequate terminal intended for connection to the earth system of the installation, by way of Suitable G.I. Strips. The continuity of the earth system shall be ensured taking into account the thermal & mechanical

stresses caused by the current it may have to carry. The components to be connected to the earth system shall include :

a) The enclosure of Unitized / prefabricated substation,
b) The enclosure of High voltage switchgear & control gear from the terminal provided for the purpose.
c) The metal screen & the high voltage cable earth conductor,
d) The Metal frame of transformer,
e) The frame &/or enclosure of low voltage switchgear,

6.12.0 Internal Illumination: There shall be arrangement for internal lighting activated by associated switch on doors for HV & LV compartments separately. The Illumination should be done by using energy efficient lighting fixtures complete, lamps/tubes and accessories. The Min. illumination(LUX) shall be maintained at the ground level inside the CSS/PSS as 150.

6.13.0 Labels: Labels for warning, manufacturer's operating instructions etc. & those according to local standards & regulations shall be pasted / provided inside and shall be durable & clearly legible.

6.14.0 Painting and Fabrication process :

a) The paints shall be carefully selected to withstand tropical heat rain. Epoxy based paints should be provided for the purpose and applied after 7-tank treatment of the metal surface. The paint shall not scale off or crinkle or be removed by abrasion due to normal handling. For this purpose powder coating shall be used.
b) The Colour of the Package Sub-station shall be as per I.S. 632 if not specifically told during approval of ordering of L1 bidder
The Colour of the Package Sub-station shall be and IS 632 if not specifically told during approval of drawing after placement of Purchase Order.
c) Special care shall be taken by the manufacturer to ensure against rusting of nuts, bolts and fittings during operation. All bushings and current carrying parts shall be cleaned properly after final painting.
d) The fabrication process shall ensure that there are no sharp edges on the GI sheets used.

6.15.0 Cable Box :

- The cable boxes shall be so located at convenient height to facilitate easy cable jointing work.
- The Cable termination shall be done by Heat shrinkable Termination method and adequate clearances shall be maintained between phases for Termination. Cable Termination is within the scope of work for Turn Key Execution only.
- For RMU Compartment Cable termination arrangement should be suitable for terminating 11 KV (E),3CX300 SQ. MM XLPE Cable
- For LT MCCBs Cable termination arrangement should be suitable for terminating 1.1 KV (E),4CX300 SQ. MM XLPE Cable
- Clearance should be such that the Cables will get bending radius as per IS 1255

6.17.0 Enclosure GTP:

1)	Type of Ventilation for a) Normal Condition b) Hot Condition	 - Natural - Natural
2)	Compartmentalized	Yes
3)	Rated temperature enclosure class	K 10
4)	Degree of protection for external enclosure	For transformer compartment IP 23 and for others HT & LT Switchgear panels IP 54
5)	Applicable Standard	IEC 62271 / 61330
6)	Enclosure material	Galvanized sheet Steel/Powder Coated CRCA
7)	Thickness of sheet (GI only)	2mm for enclosure. 1.50 mm for non load bearing enclosure and 2.00 mm for other part of Enclosure 4mm for CSS/PSS Base.

7.0.0 SCADA Compatible 3 Way RMU: shall be complied as per latest technical specification of WBSEDCL, available in website.

8.0.0 11/0.415 KV,1000 KVA Dry Type Transformer (Resin Cast): Shall be as per latest technical specification of WBSEDCL, available in website.

9.0.0 <u>LT SYSTEM</u>

9.1.0 System:-a) Declared voltage :- 3 Phase, 4-wipe, 415V (±5%), 50 Hz,
b) Neutral: – Solidly earthed at substation.

9.2.0 General finish: - Tropical, totally enclosed, metal-enclosed, weather-proof, vermin and dust proof.

9.3.0 Enclosure: - Dead Front type of enclosure

9.4.0 Earthing:

Earthing arrangement shall be provided for earthing each cable, PVC cable gland, neutral busbar, chassis and frame work of the cubicle with separate earthing terminals at two ends. The main earthing terminals shall be suitably marked .The earthing terminals shall be of adequate size, protected against corrosion, and readily accessible. These shall be identified by means of sign marked in a legible manner on or adjacent to terminals.

Neutral bus bar strip shall be connected to Earthing terminal with help of GI/Al strip of suitable capacity & with nut-bolt arrangement.

9.5.0 Bus bar :

Bus bar shall be of high conductivity Aluminum (E91E) supported on insulators made of non-hygroscopic, non-inflammable material with tracking index equal to or more than that defined in BIS. The main bus bars shall have uniform current ratings throughout the length as specified in data sheet / job specification. The current rating of the neutral shall be same that of the phase bus bars. Removable neutral links shall be provided on feeders to permit isolation of the neutral bus bar.

Both horizontal and vertical bus bars, bus joints and supports shall be capable of withstanding dynamic and thermal stresses of the specified short circuit currents for 1 second. Only zinc passivated or cadmium plated high tensile strength steel bolts, nuts and washers shall be used for all bus bar, joints and supports. The short circuit capacity of the neutral bus bars shall be in line with IS: 13947. The hot spot temperature of bus bars including joints at design ambient temperature shall not exceed 95 °C for normal operating conditions.

The current rating as defined for switchboard and components in data sheet / job specification are for design ambient temperature at site conditions and for being inside the cubicle at fully loaded condition. The vendor shall suitably de-rate the nominal rating to suit the above condition.

All bus bars shall be insulated with heat shrink PVC sleeves of 1100V grade, red yellow and blue color shall be used for phase bus bars and black color shall be used for neutral bus bars. Removable type shrouds shall be provided for joints.

Minimum clearance between live parts, between live parts to neutral and/or earth shall be 19mm. However clearances between terminals at components shall be as per applicable individual standard for components.

Interconnections between the main bus bars and individual units shall be made by using vertical Aluminium bus bars of adequate rating. These uniform cross section interconnections shall be in separate compartment and fully shrouded. Vertical bus bars for circuit breaker panels shall be sized depending upon the rating and number of breakers per vertical panel. All joint surfaces at aluminum to copper joints shall, if provided, be silver / tin plated and provided with bimetallic spacer plates (ALCO sheets)

9.6.0 BILL of Materials For 1000 KVA CSS/PSS :

i) 1 no. 1600 Amp ACB as Incomer

ii) 9 nos. 4 Pole 250A MCCBs as Outgoing

iii) 2000 Amp Al Bus Bar

iv) Incoming vertical tapping Bus bars (Al) from main Bus Bar to Outgoing MCCB

v) Outgoing vertical Bus bar from MCCB for Cable Connection

vi) 3 nos. Current Transformers of 2000/5A, 5 VA, Epoxy Moulded CT to be used for metering of LT Side. (CT to be placed between the connection between Transformer secondary and LV panel ACB). The Secondary Terminals of the CT's shall be individually wired, using 2.5 sq mm flexible stranded copper wires (with color coding and ferrules at both ends) up to a disconnecting, stud type Terminal block located

at a suitable height. The C.T secondary shall be covered with sealable transparent covers.

9.7.0 EQUIPMENT SPECIFICATION:

The design should comply for the following standards.

1.	IEC-439-1, 1992	Low voltage Switch gear and Control gear assemblies Part-I, type tested and partially type tested assemblies.
2.	IEC-947-1, 1998	Low voltage Switch gear and Control gear Part-I general rules.
3.	IEC-1180-1, 1992	High voltage test techniques for low voltage equipment Part–I definition test and Procedure requirement
4.	IEC-529, 1989	Degree of protection provided by enclosures (IP code)

9.7.1 Air circuit breaker (ACB)

These shall be fixed type with electrically operated (MFO type) mechanism. The short circuit mechanism and breaking capacity as shall be supported by test certificate. The test certificates should be from CPRI / any Govt. approved recognized test house / laboratory.

The circuit breaker shall be fitted with CT operated thermal overload and short circuit releases devices for suitable current rating.

a) Overload releases should be settable from 50% to 100% of the rated current In.

b) Ambient temperature compensated type and there should not be de-rating of ACB current carrying capacity at 50°C. The testing of ACB for the temperature rise shall be carried out by the manufacturer as per the prevailing, IS / IEC or any other international standards.

c) ACB shall be provided with very sensitive overload and short circuit release. Short circuit release should have settable value as required with an adjustable times having setting range of 40 – 460 m seconds, to have a proper co-ordination with short circuit release of outgoing MCCBs.

1)	Service voltage	- 415 volts
2)	No. of break / pole	- one
3)	Frequency	- 50 c /s
4)	Rated insulation voltage	-1000 volts
5)	Rated short circuit breaking capacity:-	
	i) Rated services S/C breaking capacity Ics (rms)	– 36KA
	ii)Rated ultimate S/C breaking capacity Icu (rms)	– 36KA
6)	Break Time	- less than 40ms
7)	Rated short time withstands current	- Icw 50kA for 1 sec.
8)	Suitable for outdoor installation.	

9) It shall conform to IS 13947 / pt.2 / 1993 with latest amendment, if any.
10) Performance category - Utilization category – A.
11) The status of open and close shall be clearly visible.
12) The trip indication separated for overload and individual phase wise trip indication for short circuit to be provided.
12) The ACB shall have the provision to lock the operating mechanism in off position.
13) The operating mechanism should be form front and the compartment should have the degree of protection IP – 67.
14) Separator shall be provided between all phases inside. ACB enclosed to prevent travel of arc during short circuit.
15) The CT's mounted for thermal overload release shall have secondary winding inaccessible including tripping mechanism of O/L and magnetic releases to avoid tampering CT's should also have provision of separators.
16) Two nos. earthing bolts for propose of earthing of ACB may also be provided & suitable for G.I stay wire of size 7 / 10 SWG.
17) The bus bar size shall be confirming to relevant IS and the neutral bus bar shall be of same wire of size as phase bus bar and should be suitable for connecting neutral.
18) The ACB shall be tested in accordance with the provision of IS: 13947 – Part I or relevant IEC.
19) ACB should have low voltage release coil.

9.7.2 Moulded Case Circuit Breaker (MCCB):

The rated ultimate Short Circuit Breaking Capacity (I_{CU}) shall be 36KA & the rated service short circuit breaking Capacity (I_{CS}) shall be at least 75 % of I_{CU}

9.7.3 Interconnecting bus bar :

Bus bar shall be of high conductivity Aluminum (E91E) supported on insulators made of non-hygroscopic, non-inflammable material with tracking index equal to or more than that defined in BIS. The main bus bars shall have uniform current ratings throughout their length as specified in data sheet / job specification. The current rating of the neutral shall be half that of the phase bus bars. Removable neutral links shall be provided on feeders to permit isolation of the neutral bus bar.

Only zinc passivated or cadmium plated high tensile strength steel bolts, nuts and double spring washers shall be used for all bus bar, joints and supports.

The hot spot temperature of bus bars including joints at design ambient temperature shall not exceed 95°C for normal operating conditions. It must be recorded during type tests.

The current rating of the bus bars shall be as required for design ambient temperature at site conditions and for being inside the cubicle at fully loaded condition. The vendor shall suitably de-rate the nominal rating to suit the above condition.

Minimum clearance between live parts, between live parts / neutral to earth shall be 19mm. However clearances between terminals at components shall be as per applicable individual standard for components.

Interconnections between the main bus bars and individual units shall be made using vertical / horizontal aluminum bus bars of adequate rating.

9.7.4 LT metering:

Shall be as per clause no. 9.6.0 against Bill of Materials for 1000 KVA PSS/CSS. The voltage circuit from Bus Bar to be provided for energy meter.

10.0.0 TYPE TESTS For CSS/PSS :

1)11 kV / 415 V Compact substations HT switchgear must be type tested for 20KA/1sec.
2) Enclosure must be type tested for IAC 20kA/1sec and Utilization category – A.
3) Enclosure must be type tested for Ingress protection on each compartment.
4) It is mandatory to have temperature rise test on enclosure for K10 class with all the accessories fully loaded..

[Type test of other equipments have been guided in respective technical specifications]

10.1.0 Routine & Acceptance Test of CSS?PSS:-

This will be guided by relevant IS.

11.0.0 DRAWINGS:

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

i) Schematic diagram
ii) Instruction manuals
iii) Catalogues of spares recommended with drawing to indicate each items of spares
iv) List of spares and special tools recommended by the supplier.
v) Copies of Type Test Certificates as per latest IS/IEC.
vi) Drawings of equipments, relays, control wiring circuit, etc.
vii) Foundation layout drawings with detailed loading data, details of all support reactions etc.
viii) Drawing of all other equipments to be submitted as per respective technical specification.

12.0 <u>Inspection & Testing:-</u>

12.1 Inspection & Testing as already mentioned the equipment shall be subjected to routine & other acceptance test as per provisions in the relevant I.S.

12.2 WBSEDCL reserves the right to send its Engineers if so, desires to witness manufacturing process and to reject either raw materials or finished products found to be not complying with requirement of the specification and also shall have the right to select any/all equipment from the lot offered for tests.

12.3 The manufacturer shall give at least fifteen (15) days advance notice regarding readiness of such Inspection and testing and shall submit the sets of work test

certificates of the materials/ equipment offered for Inspection and testing indicating probable date of Inspection and testing.

12.4 The supplier shall arrange all possible facilities for such Inspection and testing at any time during the course of manufacturing, free of cost.

12.5 The transformer may be stage inspected at the factory of the manufacturer. The manufacturer shall intimate in advance in writing to the purchaser about the stages of manufacture & subsequent readiness of the transformers to enable him to carry out stage inspection & final inspection and testing of the finished transformers.

12.6 The stage inspection may be carried out at the discretion of the purchaser during the process of manufacturing of the transformers. The purchaser shall intimate at least 15(Fifteen) days in advance about the different stages of manufacturing. The manufacturer need not stop the process of production because of the program for stage inspection of the Purchaser or for non conduction of stage inspection on part of the purchaser.

12.7 While offer for final inspection the following points should invariably be taken care of:

I. Name plates should be welded on the tanks of the transformer.

II. Suitable provisions should be there to seal the transformer with seals having wires so that inside of the transformers cannot be accessed without removing the seals.

13.1 Test Certificates:-

Seven Copies of Test Certificates as mentioned above are to be furnished to WBSEDCL for acceptance before issuance of instruction for dispatch of the equipment. Anything not covered by this specification will be as per relevant ISS or other standard Specification.

SCHEDULE A

SCHEDULE OF GURANTEED TECHNICAL PARTICULARS FOR CSS/PSS ENCLOSURE (PART 1)

Sl No.	Particular	GTP to be filled by Vendor
1	Manufacturer	
2	Manufacturing and test Standards	
3	Dimension of Enclosure	
4	Base Frame Material & Thickness	
5	Enclosure Material & Thickness	
6	Sheet Thickness	
	2 Front door LT Chamber	
	3 Front Door VCB Chamber	
	4 Structural members (Vertical & Horizontal)	
	5 Top Cover	
	6 Bottom Sheet	
7	Colour of Enclosure	
8	Protection Class	
	b) 11 kV Panel Compartment	
	c) 1000 kVATransformer Compartment	
	d) 415 V LT Panel Compartment	
9	Temperature Class	
10	Gross Weight (Approx.)[Including all Equipments]	
11	Ventilation System (Yes/No)	
12	Lifting Arrangement (Yes/No)	
13	Inside Illumination Facility (Yes/No)	
14	Maximum Ambient Temperature	
15	Maximum Temperature Rise	
16	Padlocking Arrangement	
17	Sealing Arrangement	

SCHEDULE OF GURANTEED TECHNICAL PARTICULARS FOR 415V LT DISTRIBUTION PANEL (PART 2)

Sl No.	Particular	GTP to be filled by Vendor
1	Manufacturer	
2	Manufacturing and test Standards	
3	Rated Voltage	
4	Bus Bar Current Rating	
5	Size of Main Bus Bar	
6	Sheet Materials & Thickness	
7	Type & Make of Indication Lamp	
8	**Current Transformer :**	
	a) Current Ratio	
	b) Class of Accuracy	
	c) Burden	
	d) Type	
	e) Make of CT	
9	**Incoming Feeder :**	
	a) Amp Rating of Incoming 4 Pole ACB	
	b) Make of ACB	
	c) Rated Short Circuit Breaking Capacity	
	d) Type of Protection	
	e) Type (Drawout/Fixed)	
10	**Outgoing Feeders :**	
	a) Make of 4 Pole MCCB	
	b) Rated Short Circuit Breaking Capacity	
	c) Type of Protection	
	d) Type of MCCB	

[SCHEDULE OF GURANTEED TECHNICAL PARTICULARS FOR RMU & 1000 KVA 33/0.415 KV DRY TYPE TRANSFORMER SHOULD BE SUBMITTED AS PER RESPECTIVE TECHNICAL SPECIFICATIONS]

WEST BENGAL STATE ELECTRICITY DISTRIBUTION COMPANY LIMITED (A Govt. Of West Bengal Enterprise)

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TECHNICAL SPECIFICATION OF 1000 KVA, 11/ 0.415 KV DRY TYPE (CAST RESINE TYPE) OUTDOOR/ INDOOR TRANSFORMERS

1.0 Scope:

This specification covers design, manufacture, testing and supply of 1000 KVA, 11/0.415 KV, Dry (CAST RESIN) Type Distribution Transformers as per details furnished.

2.0 Location:

The Transformers may be installed Outdoor/Indoor anywhere in West Bengal. The elevations of the system mean sea level shall not exceed 1000 meters.

3.0 System Details:

Both the 11 KV & 415 V systems are solidly earthed at the neutral points of the star.

4.0 Weather Conditions:

4.1. The area is also subject to heavy monsoon rains, 80 to 90% of the annual precipitation being in the June to October.

Maximum temperature of air in shade	50ºC
Minimum temperature of air	4ºC
Maximum temperature of air in sun	60ºC
Maximum Relative Humidity/Minimum Relative Humidity	100% / 50%
Average number of thunderstorm day per annum	100
Number of months of tropical monsoon rainy Condition Per annum (June to October)	4.5
Average rainfall per annum	200 cm
Maximum wind pressure	150 kg/m^2
Maximum Wind Speed	50 m/Sec
Maximum Height above sea level	1000 mtr.
Basic Horizontal Seismic Co-efficient	0.04

4.2. For the purpose of this specification, the maximum daily average ambient temperature shall be 40ºC over 24 hours period.

5.0 Standards:

5.1. Transformers covered by this specification shall, unless otherwise specified by built to conform Indian Electricity Rules, wherever applicable and other ISS as mentioned below

IS 2026(Part I to V) amended up to date	Distribution Transformers
IS 11171	Dry Type Transformers
IS 12063	Degree Of Protection Provided by Enclosures
IS 3347	Porcelain Transformer Bushing
IS 5. IS 104 & IS 2932	Colour shade and Colours for ready mixed paint and enamels
IEE C57.12.01-1988	Dry Type Transformers
IEC 60076	Dry Type Transformers
IEC 60726	Power Transformers – Insulation levels, dielectric tests and external clearances in air
IEC 60905	Loading Guide for dry type transformers
BS 171	Power transformers Specification for
CBIP standard	insulation levels and dielectric tests

5.2. In the event of a conflict between the above standard and the specification, the latter shall govern.

6.0 Rating and Central Data for Dry type Distribution Transformer:

6.1. Core type three phase Dry type step down two winding distribution Transformers for installation with weather condition as stated above.

6.2. Rating : 1000 KVA.

6.3. Number of phase : Three

6.4. Frequency : Transformer shall be suitable for continuous operation with a frequency variation of ±3% from normal 50 c/s without exceeding the specified temperature rise.

6.5. Type of cooling : ANAN

6.6. Voltage Ratio : 11/0.415 KV

6.7. Vector Group Reference : Dyn11

6.8. Category : Dry, Air cooled, Fully encapsulated, Cast Resin Type

7.0 Connections :

The formation of Delta for H V winding and Star for L V winding including Neutral and the relevant interconnection shall be made outside the Core-Coil assembly by providing enough support insulation.

The size (cross section) of the neutral connection conductors and jumpers must be of same size as that of phase connecting conductors and jumpers which shall be properly supported and insulated.

8.0 Temperature Rise :

i) Average winding temp rise by resistance method above 50ºC max. ambient shall not exceed 115ºC(With or without Enclosures) with a maxm. permissible hot-spot temp. of 15ºC over and above specified temperature rise limit for that particular class of insulation.

ii) Core, metallic parts solid insulation and associated materials shall in no case reach a value that may damage these materials or reduce their life expectancies.

9.0 Short Circuit Impedance: As per Annexure - ‘ B ’

10.0Terminal Arrangement:

i) HT side:-

The HT side shall be shall be suitably terminated to 3 core 185 Sq. mm. XLPE cable emanated from the VCB of the 3-way RMU of the CSS/PSS.

ii) LT side:-

The LT side shall be suitably terminated to the Aluminium LT Bus Bars (2000 Amp) of the CSS/PSS.

11.0 Leads:

All leads of the windings, connection of the windings or their wires to one another to terminal bushing properly insulated and covered with insulation sleeves. The Brazing materials shall have higher melting temperature above 300 ^{0}C and preferably above 400 ^{0}C for better thermal endurance and mechanical strength. The tenderer shall specifically mention the method and materials to be used by them for lead connection.

12.0 Conductors: Copper as indicated in Annexure - 'C'.

13.0Tap Changing Arrangement:

Link Type Off Circuit Tap Changing Arrangement should be provided in the Transformer. **Link type Taps** ranging from + 5% to -7.5% in steps of 2.5% on H.V winding for H.V. variation. The Tap link shall be located in a convenient position so that it can operated/changed from ground level. The link connection should be properly marked. The link connection diagram in separate metal sheet shall have to be provided nearby. The same should also be mentioned in Rating & Diagram plate.

14.0 Enclosure & fitments

14.1. The enclosure:-

The transformer shall not have any enclosure to itself and will be placed in the compartmentalized enclosure of the CSS/PSS having degree of protection of IP 23.

The fitments shall comprise the following;

i) 1 nos. Embedded 4(Four) channel Temperature sensor 1 channel. each for Core & winding shall be provided. Transducers of 4 to 20 mA are also to be provided so that those data may be sent for monitoring from remote end through SCADA. Those ports shall be terminated at a suitable location in the 3-way RMU compartmentalized enclosure.

ii) Lifting lugs on top cover of the main tank.
Lifting lugs of adequate capacity is to be provided in the Top yoke fixing assembly so that the entire Core Coil assembly along with all accessories may be lifted during it's entire lifespan..

iii) Diagram and rating plate, **Danger Plate** at a suitable location in the transformer compartmentalized enclosure.

iv) Two earthing terminals

v) Skid channels with rounded corners to be provided along the width of the transformer with hole centers at 457mm (18φ) at the centre of gravity of the whole transformer. Open side of the channels should be outwards.

vi) Property Plate along with Asset Codification No.:

Asset codification no. for the ordered quantity shall be communicated to the supplier after placement of order (In case of Departmental procurement only). Necessary Engrave/Embossing (cold punch) shall be done on the Transformer compartment with 28 no font size and DTR name and diagram plate with font size not less than that used for marking KVA rating of the DTR.

If cold punch on the transformer compartmentalized enclosure is not possible then separate property plate (details marking of the plate shall be submitted with the transformer drawing for approval) shall be welded to the transformer compartment with the following details:-

1. Ratings :
2. Manufacturer's Sl. No. :
3. Manufacturer's Name :
4. P.O. No. :
5. Year of Manufacturing :
6. Property of : WBSEDCL
7. Asset Code Number : Asset Code Number(For Departmental Procurement only) : (10 digit alpha numeric numbers as allotted by the purchaser)

15.0 Core

15.1. The magnetic core shall be built of very low loss Silicon steel, cold rolled grain oriented steel. Core should be of stack core type.

15.2. The materials used for insulating the sheets, shall have high interlamination resistance and rust inhibiting property. It shall not be deteriorated by ageing from hottest operating temperature and clamped pressure of the core disintegrated due to mechanical modes of core vibration. It shall not have the least tendency to absorb moisture, or to react with the moisture present in the air thus accelerating deterioration of insulation.

15.3. The assembled core shall be securely clamped in the lines and in the uniform pressure so as to minimize the noise from the core.

15.4. Core Clamping-The core-clamping frame shall be provided with lifting eyes for the purpose of lifting/shifting. The whole core shall be electrically connected by copper strip of adequate section to the core frame at two separate points for being eventually earthed through the tank to drain off electrostatic potential that may be built up.

Core base and top and bottom of yoke shall be supported with M.S. channel of proper size and properly bolted together for stack type core.

15.5. Flux density- Flux density in any part of the core and yoke at rated voltage & frequency shall be 1.69Tesla.

The maximum flux density in any part of the core and yoke shall not exceed 1.9 Tesla.

15.6. All core clamping bolts shall be effectively insulated.

15.7. Adequate provision shall be made to prevent movement of the core and winding relative to the enclosure during transport and installation or while in service.

15.8. The core shall conform to : IS: 3024-1965

Electrical Sheet Steel & IS: 649 – 1983 method of test and steel sheet.

15.9. Core insulation- Class "H" grade insulation paper of thickness 20 mils (0.5mm) shall be used and make should be clearly stated in the offer along with test certificates.

16.0 Windings:

16.1 Transformer shall be provided with the requisite number of windings (as detailed hereunder in cl.16.2) and shall be designed to withstand the electromechanical stress exerted under short circuit conditions as per ISS: 2026 -1977. Class "H" Insulation shall be used. The winding of Dry Type transformer will be encapsulated.

16.2 Construction details :

HV & LV Coils

i) Active Material – Electrolytic copper conductor
ii) H.V. Winding – Nomex insulated round conductor or Foil winding
iii) HV --- Multiple rectangular copper strip or Foil winding with Nomex inter – layer insulation to achieve best short circuit withstand capability. LV -= Copper strip/foil of spiral type or Foil winding.
iv) Coil Insulation-Insulated with Nomex and glass tape
v) Coil spacers & supports-High temp. Epoxy fiber glass.

16.3 The insulation level of the Windings shall be as follows as per IS:11171 –1985 or CEA guideline.

Voltage	Impulse Voltage	Short duration Power frequency Voltage
415 V	-	**3 KV**
11000 V	**75 KV**	**28 KV**

16.4 The winding shall be so designed to reduce to a minimum the out of balance forces in the Transformer (at all voltage ratios).

16.5 Bracing of Windings:

(1) The windings and connections of all transformers shall be braced to withstand shocks which may occur during transport or due to switching short circuit and other transient conditions during service.
(2) Coil clamping rings, if provided, shall be of steel or of suitable insulating material.
(3) The winding shall be assembled on the core co-axially for magnetic balance and symmetrically for electrical balance. Spacers, wedges shall be robust, hard insulations are so fitted in the winding so that they will neither move nor permit any relative movement of any part of the winding during normal service and under a terminal short circuit, not mechanically injure any insulation in the windings.

17.0 Overloads:

Dry type AN cooled transformers, can be overloaded according to IEC 60905 Loading guide for dry type transformers.

18.0 Bushing:

18.1 For 11 KV, 12 KV Bushing will be used and for 415 volts, 1.1 KV Bushing shall be used. Bushing of same voltage class shall be interchangeable.

18.2 Standard practices for Bushing as per IS 347 amended up to date shall be mounted on the side of the enclosure and not on the top cover.

Voltage Class	Indian Standards	
	For Porcelain Parts	For Metal parts
Up-to 11 KV Bushing	IS: 3347 / Part – I (Sec – I) (1979)	IS: 3347 / Part-I(Sec-2) (1979)
36 KV Bushings	IS: 3347 / Part - III (Sec - I) (1972)	IS:3347 / Part-III(Sec-2) (1982)

18.03 The clearances in air between live and conductive parts and live conductive part to earthed structures shall be as follows in cable end box:

Nominal System Voltage (KV RMS)	Test Voltage Impulse (KVP)	Phase to Phase (MM)	Phase of Earth (MM)
0.415	NIL	45 mm. additional clearance after fitment of socket suitable for 3 sets of 400 Sq. mm. LT Power cable	**20** mm. additional clearance after fitment of socket suitable for 3 sets of 400 Sq. mm. LT Power cable
11	75	**130** mm. additional clearance after fitment of socket suitable for 1 set of 185 Sq. mm. HT Power cable of 12 KV grade	**80** mm. additional clearance after fitment of socket suitable for 1 set of 185 Sq. mm. HT Power cabl of 1.1 KV grade.

19.0 Cooling Arrangement:

19.1 The transformer shall be suitable for loading of 100% continuous maximum rating with 'ANAN' cooling without exceeding the thermal limit.

19.2 Painting:

19.3 The surface to be painted shall be completely cleaned & made free from all rust, scale or foreign adhering matter of grease.

19.4 After thorough metal treatment enclosure surface shall be given a **primary coat of Zinc chromate** and two coats of **dark admiral gray (IS 104 & IS 2932) enamel / powder paint.** Double coat of corrosion resistant primer shall be applied before painting. The inside of the enclosure shall have semi glossy paint finish. All metal parts not accessible for painting shall be made of corrosion resistant material. All steel surface exposed to weather, shall be given a primary coat of Zinc chromate and two coats of dark admiral gray paints.(IS 104 & IS 2932)//

19.5 All paints shall be carefully selected to withstand tropical heat and extremities of weather. The paint shall not scale off or winkle or be removed by abrasion due to normal handling.

19.6 All nuts and bolts used in the Transformer for external fittings shall be galvanized or zinc passivated and painted with body paint.

20.0 Test & Inspection (As per I.S.S):

20.1. **Routine Test:** All Transformers shall be subject to routine tests at the manufacturers Works. The following tests are to be carried out.

(a) Measurement of winding resistance.
(b) Ratio, polarity and Vector Group test.
(c) % Impedance voltage at Principal Tap position at 50 Hz & 145°C.
(d) No load loss at 50 Hz.
(e) Load Loss at 145°C at 50% loading.
(f) Load Loss at 145°C at 100% loading
(g) Insulation resistance.
(h) Induced over voltage withstand.
(i) Separate source voltage withstand
(j) Unbalance current: The maximum value of unbalance current in Transformer shall not exceed 2% of full load current as per CBIP manual for Transformer.
(k) Magnetizing current at rated voltage & frequency and 110% of rated voltage & frequency.
(l) Temperature rise test will be conducted on one transformer against every Order for inspection. The temperature rise test will be performed on lowest tap at appropriate current related to the said tapping with total losses fed corresponding to minm. Voltage tapping as per IS 2026 (Part-2) 1977, amendment no.2, 1984.

20.2. TYPE & SPECIAL TESTS:

Bidder should submit Lightning Impulse withstand test, Temperature Rise Test, Dynamic Short Circuit withstand test and report from CPRI/NABL Accredited laboratory (Third party)/Govt. approved Laboratories **along with their offer having identical rating and voltage ratio and type as that of the tendered item**, carried out within last five years, as per pre-requisites of this tender, failing which their offer may not be technically accepted.

The transformer during Dynamic Short Circuit Test shall not exhibit more than 2 percent variation in percentage reactance.

Temperature rise Test shall have to be conducted at least on one transformer against each Ordered lot against the order design in presence of the Engineers of WBSEDCL.

21.0 INSPECTION

The Transformer may be stage inspected at the factory of the manufacturer. The manufacturer shall intimate in advance, in writing, to the purchaser about the stages of manufacturer & subsequent readiness of the transformers, to enable the purchaser to carry out stage inspection & final inspection and testing of the finished transformers.

The stage inspection will be carried out at the discretion of the purchaser during the process of manufacturing of the Transformers. The manufacturer need not stop the process of production because of programme of stage inspection of the Purchaser.

While offering for final inspection, the following point should invariably be taken care of:

i) Name Plates should be welded / riveted on the enclosure of the Transformer.
ii) Proper door locking and transformer sealing arrangement should be provided to ensure unwanted access to the transformer.

22.0 Contract Drawings:

22.1. The General outline drawing giving detail of dimensions and fittings should be submitted for each type of Transformer.
22.2. Name & Rating Plate drawing.
22.3. Internal assembly drawing.
22.4. Terminal arrangement drawing.
22.5. Schematic diagram for W.T. Scanner.

23.0 Over Load Capacity:

Each Transformer shall be capable of carrying sustained over load as stated in ISS.

24.0 Over Fluxing:

Over fluxing in the core shall be limited to 12.5% so that the flux density in the core does not exceed (19000 lines/sq.cm.)

The maximum flux density in any part of the core under such condition shall not exceed 19000 lines/sq.cm on the basis of M4,M5 & M6 grades as per BS 601: Part-2:1973(Specification for sheet and for magnetic core of electrical apparatus oriented Steel).

25.0 Internal Earthing Arrangement :

All metal parts of the Transformer with the exception of the individual core laminations, core associated damping plates shall be maintained at some fixed potential and core should be earthed at two positions.

26.0 Inspection & Testing:-

13.7 Inspection & Testing as already mentioned the equipment shall be subjected to routine & other acceptance test as per provisions in the relevant I.S.

13.8 WBSEDCL reserves the right to send its Engineers if so, desires to witness manufacturing process and to reject either raw materials or finished products found to be not complying with requirement of the specification and also shall have the right to select any/all equipment from the lot offered for tests.

13.9 The manufacturer shall give at least fifteen (15) days advance notice regarding readiness of such Inspection and testing and shall submit the sets of work test certificates of the materials/ equipment offered for Inspection and testing indicating probable date of Inspection and testing.

13.10 The supplier shall arrange all possible facilities for such Inspection and testing at any time during the course of manufacturing, free of cost.

13.11 The transformer may be stage inspected at the factory of the manufacturer. The manufacturer shall intimate in advance in writing to the purchaser about the stages of manufacture & subsequent readiness of the transformers to enable him to carry out stage inspection & final inspection and testing of the finished transformers.

13.12 The stage inspection may be carried out at the discretion of the purchaser during the process of manufacturing of the transformers. The purchaser shall intimate at least 15(Fifteen) days in advance about the different stages of manufacturing. The manufacturer need not stop the process of production because of the program for stage inspection of the Purchaser or for non conduction of stage inspection on part of the purchaser.

13.13 While offer for final inspection the following points should invariably be taken care of:

III. Name plates should be welded on the tanks of the transformer.

IV. Suitable provisions should be there to seal the transformer with seals having wires so that inside of the transformers cannot be accessed without removing the seals.

27.0 <u>Test Certificates:-</u>

Seven Copies of Test Certificates as mentioned above are to be furnished to WBSEDCL for acceptance before issuance of instruction for dispatch of the equipment.

Anything not covered by this specification will be as per relevant ISS or other standard Specification.

28.0 Capitalisation of losses:

No Bidder shall specify any tolerance in respect of those losses..

The evaluation of 1000 KVA; 11/0.415 KV DTR will be based upon loss capitalization on the basis of the quoted No Load Loss in KW at frequency 50 Hz and load loss in KW at 145°C. However the quoted No Load Loss at frequency 50 Hz, Load loss at 145°C. temperature, the Total Loss Figures at 50 Hz frequency & 145°C temperature at 50% and at 100% loading shall not exceed the figures as noted in Annexture-B of the specification.

The capitalized cost of No load loss (Iron loss) at frequency of 50 Hz and Load loss (copper loss) per KW at 145°C temperature at rated load, voltage and will be as follows :

i) Capitalised value of Iron loss / KW = Rs.5,64,908/-
ii) Capitalised value of load loss / KW = Rs.1,69,470/-

In the G.T.P. your quoted/ guaranteed transformer NO load loss at frequency 50 Hz & Load Loss at principal Tap position at 145°C temperature are to be specified.

If NO load loss at frequency 50 Hz & Load Loss at principal Tap position at 145°C temperature after Routine Tests in each transformer is found beyond guaranteed values of

declared in the bid offered, penalty shall be imposed for the excess loss over the corresponding guaranteed value by applying the above stated values. For fraction of a KW, penalty shall be applied pro-rata, but no bonus will be applied on vice-versa. In case above losses are found beyond the value as stipulated in our specification in Annexure-B, the said transformer will be rejected. In addition if the the Total Loss Figures observed at 50 Hz frequency & 145°C temperature at 50% and at 100% loading during Routine/Acceptance tests, if exceed the respective values noted in Annexture-B of the specification, the transformer will also be rejected.

The loss capitalisation will be applicable only for Departmental procurement and in case of Turnkey execution the Loss capitalisation will not come into picture and the loss figures shall be within values as noted in Annexture-B.

No bidder shall specify any tolerance in respect of the quoted figures of the above losses.

Accessories:

Transformer capacity is 10000 KVA (upto 11 kV Voltage class)

Sl. No.	Item	1000 KVA
1.	Terminal marking Plate Nos.	1
2.	Property & Danger Plate	1 each
3.	Earthing Terminal-Nos.	2
4.	Lifting Lugs-Nos.(for trans. Assembly)	2
5.	Platform mounting arrangement	Should be provided as per requirement of the Customer
6.	H.V. Bushings	3
7.	L.V. bushings for phases & Neutral	4
8.	Thermometers embedded in windings along with 4-20 mA Transducers for remote monitoring through SCADA	1 set in 3 phase LV winding & core only
9	Diagram Plate	1

ANNEXURE-B

Rating of Transformer	No Load (Iron) Loss at 50 Hz frequency (Watts)	Load (Copper) loss at 145°C temperature on normal Tap position (Watts)	Maximum Total Loss (NLL + LL) at 100% loading at 50 Hz & at 145°C on normal Tap position (Watts)	Maximum Total Loss (NLL + LL) at 50% loading at 50 Hz & at 145°C on normal Tap position (Watts)	Percentage Impedance on Normal tap at 50 Hz frequency and 145°C temperature at rated KVA
1000 KVA; 11/0.415KV	2000	10000	12000	4500	5.0 with IS Tolerance

ANNEXURE-C

1. Bushing Clearance: This should be as per clause No. 18.03 of Specification.
2. Winding Materials: Electrolytic Copper
3. Similar materials for both L.V. & H.V. windings should be chosen.
4. Limits of average winding temperature rise above
   50ºC maxm. ambient : 115°C
5. Tap position for Off Load Tap Changer : +5% to – 7.5% in steps of 2.5%

ANNEXURE –A

SCHEDULE OF GUARANTEED PERFORMANCE TECHNICAL AND OTHER PARTICULARS FOR 1000 KVA 11/0.415 KV, DRY(CAST RESIN) TYPE, DISTRIBUTION TRANSFORMERS

The Tenderers shall have to submit details applicable to the equipments offered in the forms given below

GUARANTEED TECHNICAL PARTICULARS					
Sl.No.	Particulars				
1.	Name and address of the manufacturer		:		
2.	Country of origin		:		
3.	a) Applicable standard		:		
	b) Service		:		
	c)Type of Dry Type Transformer		:	Cast Resin	
4.	Maximum continuous rating (in KVA)		:		
5.	No load voltage ratio at Principal (Nominal) tap (in KV/KV)		:		
6.	Rated frequency (in Hz)		:		
7.	Number of phases		:		
8.	Type of Cooling		:		
9.	Connections		:		
	(i) H.V. Winding		:		
	(ii) L.V. Winding		:		
10.	Vector Symbol		:		
11.	Tapings		:		
	(a) Range		:		
	(b) Number of steps				
	(c) Variation of voltage in each step (in KV)				
	(d) No load voltage ratio in each tap (in KV/KV) for 1000 KVA 11/0.415 KV Transformer.				
	Tap Number	Voltage ratio in KV/KV		Tap Number	Voltage ratio in KV/KV
	1.			4.	
	2.			5.	
	3.			6.	

GUARANTEED TECHNICAL PARTICULARS			
12.	(i) Temperature rise under normal operating condition above ambient temperature	:	
	(a) Windings (in Degree C)	:	
	(b) Maximum hot spot temperature of Copper windings (in Degree C)	:	
13.	Magnetizing current referred to H.V. at rated frequency	:	
	(a) at 90% rated voltage : (in Amps)	:	
	(b) at 100% rated voltage : (in Amps)	:	
	© at 110% rated voltage (in Amps)	:	
14.	Power factor of magnetizing current at 100% rated voltage & frequency	:	
15.	No load current at rated voltage and Rated frequency (in Arms)	:	
16.	No load loss in KW at rated frequency and voltage	:	
	(a) at Lowest tap	:	
	(b) at principal tap	:	
	© at highest tap	:	
17.	Load loss in KW at 145°C at Rated output and frequency	:	
	(a) at Lowest tap	:	
	(b) at principal tap	:	
	© at highest tap	:	
18.	Total loss in KW at 50 Hz & 145°C **at 50% Load**		
19	Total loss in KW at 50 Hz & 145°C **at 100% Load**		
20.	Percentage Regulation at full load at 145°C	:	
	(a) at unity power factor	:	
	(b) at 0.8 power factor lagging	:	
21.	Efficiencies at 145°C (in percentage)	:	
	a) at full load (i) at unity power factor	:	
	(ii) at 0.8 power factor lagging	:	
	(b) at ¾ full load (i) at unity power factor	:	
	(ii) at 0.8 power factor lagging	:	
	(c) at 1/2 full load (i) at unity power factor	:	

GUARANTEED TECHNICAL PARTICULARS			
	(ii) at 0.8 power factor lagging	:	
22.	Impedance voltage on rated KVA base at rated current and frequency for the Principal tapping 145°C (in percentage)	:	
23.	a) Reactance voltage at rated current and frequency for the principal tapping at 145°C. (in percentage) b) Resistance voltage at rated current and frequency for the principal tapping at 145°C (in percentage)	: :	
24.	Resistance at H.V. base at 75^0C		
	(a) at Lowest tap	:	
	(b) at principal tap	:	
	(c) at highest tap	:	
25.	Reactance at H.V. base at 75^0C.		
	(a) at Lowest tap	:	
	(b) at principal tap	:	
	(c) at highest tap	:	
26.	Withstand time without injury for three phase dead short circuit at terminal (in seconds)	:	
27.	Short time current rating for short circuit with duration	:	
	a) H.V. winding (in K. Amps)	:	
	b) L.V. winding (in K Amps)	:	
	c) Duration (in seconds)	:	
28.	Permissible overloading with time	:	
29.	Core :		
	i) Type	:	
	ii) Flux density of Core and yoke at principal tap	:	
	a) at rated voltage at 50 Hz (in lines/sq.cm	:	
	b) at 112.50% rated voltage at 50 Hz (in lines/sq.cm.)	:	
	iii) Thickness of Stamping (in mm)	:	
	iv) Type of insulation between core laminations	:	
	v) Core bolt withstand Insulation (in KV rms for 1 min)	:	
	vi) Approximate area of Cross Section of Core and yoke (in sq.mm.)	:	

GUARANTEED TECHNICAL PARTICULARS				
	vii) Material of Core clamping plate	:		
	viii) Thickness of Core clamping plate (in mm)	:		
	ix) Insulation of Core clamping plate	:		
	x) Describe location/Method of Core grounding	:		
30.	Terminal Arrangement	:		
	i) High Voltage	:		
	ii) Low Voltage	:		
31	Positive Sequence Impedance between HV & L.V. winding on rated MVA base at rated Current and frequency at 145 Deg.C. winding temperature	:		
	i) AT principal tapping (in percent)	:		
	ii) At lowest tapping (in percent)	:		
	iii) At highest tapping (in percent)	:		
32	Zero Sequence Impedance at reference temperature of 145^0C at principal tap (in percent)	:		
33	Details of windings	:		
	i) Type of Winding	:		
	(a) High Voltage	:		
	(b) Low Voltage	:		
34	Winding conductor	:		
i)	Material of the winding conductor			
	(a) High Voltage	:		
	(b) Low Voltage	:		
ii)	Conductor Area :			
	(a) High Voltage (in sq.cm)	:		
	(b) Low Voltage (in sq.cm)	:		
iii)	Current density of windings at rated KVA	At principal tapping 1	At lowest tapping 2	At highest tapping 3

GUARANTEED TECHNICAL PARTICULARS						
(a)	High voltage (Amp. per sq.cm)					
(b)	Low voltage (Amp. per sq.mm)					
iv)	Insulating material used for	:				
	(a) High voltage winding	:				
	(b) Low voltage winding	:				
v)	Insulting material used between	:				
	(a) High voltage and low voltage winding	:				
	(b) Low voltage winding and core	:				
vi)	Whether adjustable coil clamps are pro0vided for H.V. & L.V. winding (if yes, details may be given) :					
vii)	Type of Axial Coil Supports	:				
	(a) H.V. winding	:				
	(b) L.V. winding	:				
vii)	Type of Radial Coil Supports	:				
	(a) H.V. winding	:				
	(b) L.V. winding	:				
35	Insulation withstand Test voltages	:	H.V.		L.V.	
	i) Lightning Impulse withstand test voltage 9kv Peak)	:				
	(ii) Power frequency withstand test voltage (in KV rms for 1 min)	:				
	(iii) Induced over voltage withstand test voltage (in KV rms)	:				
36	Current in the winding at rated KVA	:	At principal tapping	At lowest tapping	AT highest tapping	
	(i) Low voltage (in Amps)	:				
	(ii) High voltage (in Amps)	:				
37	Voltage per turn (KV per turn)	:				
38	Ampere turn	:				
39	Number of turns	:	At principal tapping	At lowest tapping	AT highest tapping	
	(i) Low Voltage	:				
	(ii) High Voltage	:				

GUARANTEED TECHNICAL PARTICULARS					
40.	Details of Tap changer	:			
	i) Number of steps	:			
	ii) Number of Plus taps	:			
	iii) Number of minus taps	:			
	iv) Position of taps on HV	:			
	v) Type of tap changing arrangement	:			
41.	Bushing :		High voltage	Low voltage	
i)	Make	:			
ii)	Type	:			
iii)	Applicable standard	:			
iv)	Insulation withstand test Voltage	:			
a)	Lightning Impulse withstand test voltage (1.2 x 50 micro seconds in KV peak)	:			
b)	Power frequency withstand test voltage (in KV rms for 1 min)	:			
	1)Dry	:			
	2)Wet	:			
v)	Creepage distance				
	a) Total (in mm)	:			
	b) Protected (in mm)	:			
vi)	Minimum height of the bushing	:			
42.	Minimum clearance (in mm)	:			
			In Air		
			Between Phases	Phase to Ground	
	i) H.V.				
	ii) L.V.				
43.	Particulars of Enclosures & Fitment				
	viii) No of Lifting Lugs provided for lifting Core-Coil assembly	:			
	X) No of Earthing terminal Provided	:			
	i) Skid Chanel with Round Corner provided	:			
44.	Weight of Transformer, Enclosure	:			

GUARANTEED TECHNICAL PARTICULARS			
	and fitting with accessories		
	i) Untanking weight	:	
	ii) Total weight with Core, Winding, Fittings.	:	
iv)	Detail of Thermometer embedded in winding	:	
v)	Current rating of each contact of Temp meter	:	
45.	Approximate overall Dimensions (in mm)	:	
	a) Length	:	
	b) Breadth	:	
	c) Height	:	
	d) Minimum height of bottom most portion of bushing from bottom of base channel	:	
46.	Minimum clearance height for lifting Enclosures (in mm)	:	
47.	Category	:	
48.	Whether all particulars against sl. No. 1 to 46 furnished?		

SIGNATURE OF THE TENDERER
WITH COMPANY'S SEAL

WEST BENGAL STATE ELECTRICITY DISTRIBUTION COMPANY LIMITED (A Govt. Of West Bengal Enterprise)

Office of the Chief Engineer, Procurement & Contracts
Departments Vidyut Bhavan, 4th. Floor, B-Block. Bidhannagar,
Salt lake City, Kolkata-700 091

Technical Specification for Supply & Delivery of

SCADA compatible 11kV Non extensible 3-Way Ring Main Unit

1.0 **SCOPE**

1.1 This specification covers Design, Engineering, Manufacture, Assembly, testing, Inspection, packing-, delivery and unloading at site **of new "SCADA-Ready" Ring Main Units capable of being monitored and controlled by the Central SCADA.** The RMU to be supplied against this specification are required for vital installations where continuity of service is very important. The design, materials and manufacture of the equipment shall, therefore, be of the highest order to ensure continuous and trouble-free service over the years.

The RMU offered shall be compact, maintenance free, easy to install, reliable, safe and easy to operate and complete with all parts necessary for their effective and trouble-free operation. Such parts will be deemed to be within the scope of the supply irrespective of whether they are specifically indicated in the commercial order or not.

It is not the intent to specify herein complete details of design and construction. The offered equipment shall conform to the relevant standards and be of high quality, sturdy, robust and of good design and workmanship complete in all respects and capable to perform continuous and satisfactory operations in the actual service conditions at site and shall have sufficiently long life in service as per statutory requirements. In actual practice, not withstanding any anomalies, discrepancies, omissions, in-completeness, etc. in these specifications, the design and constructional aspects, including materials and dimensions, will be subject to good engineering practice in conformity with the required quality of the product, and to such tolerances, allowances and requirements for clearances etc. as are necessary by virtue of various stipulations in that respect in the relevant Indian Standards, IEC standards, I.E. Rules, I.E. Act and other statutory provisions.

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

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

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

1.1.1 Scope of Work

- Supply of SCADA Ready 3 way RMU.
- Supply of battery charger and battery.
- Supply of right angle boots for covering the bare cable lug.

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

1.4 Key RMU Components

Key RMU components are listed as follows:

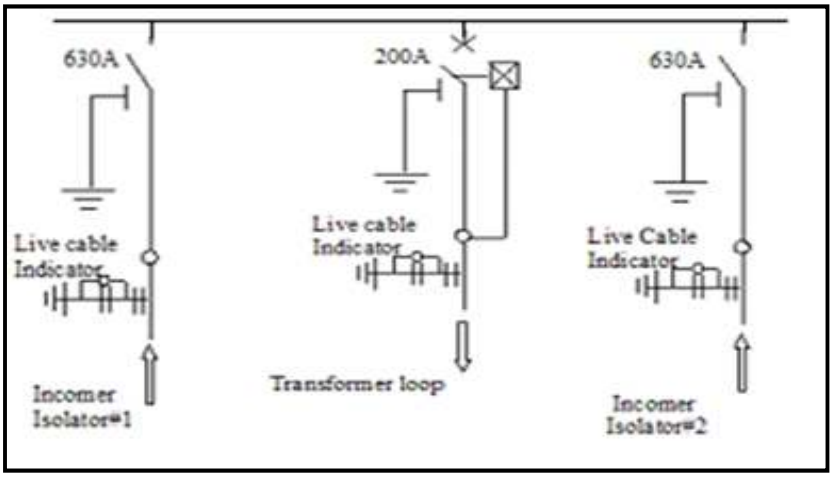
- Two (2) Isolators with earthing switches, connecting the RMU to incoming and outgoing main loop, 11 kV, **630 Amp XLPE cables of size 400/300 mm²** cross section aluminium conductor.
- One (1) circuit breaker (CB) with earthing switches, connecting the RMU to distribution transformers loop, 11 kV, 200 Amp XLPE cables of size 185 mm^2 cross section aluminium conductors.
- One numerical relays having non-directional O/C and E/F protection for each outgoing feeder. In case of 630kVA and above wet type transformer, auxiliary relay for transformer supervision shall be provided. Both the Incomers/Outgoing main Loop shall have FPI with electrical reset facility. The relay shall be of make as noted in Annexture-A.
- All necessary current sensors for metering and protection.
- All necessary potential-free contacts for indications relevant to RMU monitoring and control.
- A power supply unit, including auxiliary power transformer and battery backup, to provide stable 24 V DC sources of power for the RMU's spring-charge motors, relays etc. The power supply shall also provide for RMU enclosure lighting fixtures and power-plug receptacles for maintenance/test equipment.
- Capacitor voltage dividers serving live-line cable indicators.

A typical three-way RMU configuration is illustrated in the required space for installation of RTU and associated battery and battery charger shall have to be provided separately. That space shall approximately be 800mmX800mm and height of 1.5 meter.

The required space for installation of RTU and associated Battery & battery Charger shall have to be provided separately. That space shall approximately be 800mmX800mm and Height of 1.5 meter .

Figure-1. In this case**,** the RMU has four enclosures, one for each of the two Isolators and one circuit breaker and one for the RMU's auxiliary power supply unit and the necessary SCADA monitoring and control equipment. **The SCADA monitoring and control equipment includes the RTU and modem to be supplied by others**. The required space for installation of RTU and associated Battery & battery Charger shall have to be provided separately. That space shall approximately be 800mmX800mm and Height of 1.5 meter .

Figure-1: Typical RMU Configuration



1.5 Applicable Standards

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

The bidder shall provide an English language copy of the applicable Indian and equivalent international standards met by the proposed RMU.

Rating, characteristics, tests and test procedures etc. for the RMU , protection Relays, monitoring and control devices and accessories including current transformer shall comply with the provisions and requirements of the standards of the IEC and IS where specified. The latest revision or edition in effect at the time of bid invitation shall apply. Where references are given to numbers in the old numbering scheme from IEC it shall be taken to be the equivalent number in the new five-digit number scheme. The bidder shall specifically state the precise standard, complete with identification number, to which the various equipments and materials are manufactured and tested. The bid document may not contain a full list of standards to be used, as they only are referred to where useful for clarification of the text.

Table 1-1: Applicable Standards

Standard	Description
IEC 60529	Classification of degrees of protection provided by enclosures of electrical equipment
IEC 60298	A.C metal-enclosed switchgear and control gear for rated voltages above 1KV and up to and including 72KV
IEC 1330	High voltage/Low voltage prefabricated substations
IEC 60694	Common specification for HV switchgear standards
IEC 60265	High-voltage switches-Part 1: Switches for rated voltages above 1kV and less than 52 kV
IEC 60801	Monitoring and control
IEC 60185	Current Transformers
IEC 60186	Voltage transformers
BS 159	Busbar
IEC 60137	Bushings
CP 1013(British Code of Practice)	Earthing
IEC 60255	Specification for Static Protective Relays

Standard	Description
BS 6231	Wires and wiring
IEC 61000	Electromagnetic compatibility
IEC 60129	Alternating current Disconnector (isolators) and earthing switches
IEC 62271-200	Metal enclosed BS 5311 switchgear
IEC 62271-100	MV AC circuit breaker
IEC 60060-1 BS 923	High Voltage test technique
IEC 60034-1	Motors
IEC 60947-4-1	Control Gears
IEC 60623	Open Ni-Cd prismatic rechargeable cell
IEC 376	Filling of SF6 gas in RMU

1.6 Environmental Conditions

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

- Maximum ambiant air température: 40 ºC
- Minimum ambiant air température: 10 ºC
- Maximum relative humidity: 95 %
- Average thunder storm days per annum: 50
- Average rainfall per annum: 1450 mm
- Maximum wind pressure: 150 km/sq. m
- Altitude above mean sea level: Max. 1000 m

1.7 Distribution Network Electrical Parameters

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

- Nominal system voltage: 11 kV (rms)
- Highest system voltage: 12 kV (rms)
- Number of phases: 3 ph/3 wire
- Frequency: 50 Hz
- Type of earthing: Solid
- Rated normal current: 630 Amp (Ring Switch)
  200 Amps (Transformer Feeder Breaker)
- Power frequency withstand voltage 28 kV for 1 min
- Number of electrical operations 100 O/C

at full load current

- Rated cable charging interrupting Current for Line Switch 25A
- Rated magnetizing interrupting current for Line Switch 16A
- Minimum number of operations at rated short circuit current on circuit breaker 10 breaking operations
- Number of operations at rated short circuit current on line switches, earthing switches and CB 5 closing operations
- Basic impulse withstand voltage Ph to ph & ph to earth : 75 kV peak
- Fault level (minimum) : 18.4 kA for 3 sec for 12kV
- Rated short circuit making capacity of line switches and earthing switches and CB : 46kA peak at rated voltage
- Climatic Condition : Moderately hot and humid tropical climate conducive to rust and fungus growth.
- Visible or audible corona with switchgear energized at 12 kV phase to earth at 50 Hz : None
- Circuit Breaker : In addition to the ratings mentioned in this specification, the circuit breaker shall have following:

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

General data, enclosure and dimension:-

Sl. No	Description	WBSEDCL Requirement
1.	Standard to which Switchgear complies	IEC
2.	Type of Ring Main Unit	Metal enclosed panel type, Compact module
3.	Number of phases	3
4.	Whether RMU is Type tested	Yes
5.	Whether facility is provided with	Yes

		pressure relief	
	6.	Insulating gas	1.3 bar at 20° C
	7.	Gas leakage rate	0.1% per year
	8.	Expected operating lifetime	30 Yrs.
	9.	Whether facility is provided for gas monitoring	Yes, temperature compensated manometer can be delivered.
	10.	Material used in tank construction	Stainless steel
		Operations, degree of protection and colors	
	1.	Means of switch operation	Separate handle
	2.	Means circuit breaker operation	Separate handle and push buttons
	3.	Rated operating sequence of Circuit Breaker	O-3min-CO-3min-CO
	4.	Opening time of circuit breaker	Approx. 60-80 ms.
Testing	5.	Closing time of Circuit Breaker	Approx. 40-60 ms.
	6.	Mechanical operations of Disconnector switch	1000
	7.	Mechanical operation of earthing switch	1000
	8.	Mechanical operations of circuit breaker	2000
	9.	Disconnector switch/earth switch	3 position combined switch/earth switch
Specified		**Degree of Protection**	
	1.	High voltage live parts, SF_6, VCB	IP67
	2.	Front cover mechanism	IP2X
	3.	Cable cover	IP 2X
	4.	Outdoor Enclosure	IP54

1.8 The specified RMUs shall be subject to routine tests and acceptance tests. Where applicable, these tests shall be carried out as per the standards stated above. Prior to testing, the bidder shall prepare and submit a detailed test plan for review and approval by the Employer.

1.9 **RMU Design Features**

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

- Availability, maintainability and life span
- Ability to operate in severe outdoor environmental conditions
- Immunity to electrical stress and disturbance
- Acceptable insulation properties

- Termination to SCADA Terminal Box for convenient RTU interconnection features

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

1.11 Availability and Maintainability

1.11.1 Availability

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

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

1.11.2 Maintainability

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

.1.12 Outdoor Features

1.11.3 General

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

The equipment in the proposed outdoor RMU shall be conformably coated to meet these climatic conditions. In this respect, standards such as IEC 60870-2-2 covering equipment, systems, operating conditions, and environmental conditions shall apply along with IEC 60721, which covers the classification of such conditions. In particular, the RMU equipment shall have been type tested for continuous operation under the environmental conditions identified in Clause 1.6.

In addition to the above, materials promoting the growth of fungus or susceptibility to corrosion and heat degradation shall not be used, and steps shall be taken to provide rodent proof installations.

All live parts, high voltage components, excluding the HV cable termination of the switchgear shall be insulated/ protected in SF_6 to provide complete proofing against dangers of flashover between phase and earth and between phases. In particular, the equipment shall be climate free in that no high voltage connection will be exposed to the environment.

1.11.4 Corrosion Protection

The fabricated parts are pretreated using 7 tank process and then coated by layer of zinc phosphate. A finish coat with high scratch resistance or epoxy powder finish paint shall be applied over the primer. The coat thickness shall be of the order of 40 to 60 micrometers. The Employer shall approve the finish-coat color. The RAL-7032/RAL7035/IEC 632 code will be agreed upon with the Contractor during the early design phases of project implementation.

1.11.5 Material

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

1.12 Immunity to Electrical Stress and Disturbance

The electrical and electronic components of the RMU shall conform to relevant standards concerning insulation, isolation, and immunity from electromagnetic interference, radiated disturbance, and electrostatic discharge. The ability to meet these requirements shall be verified by type tests carried out by accredited test laboratories that are independent of the bidder and/or the manufacturer of the RMU components. Certified copies of all available type test certificates and test results shall be included as part of the bidder's proposal. Failure to conform to this requirement shall constitute grounds for rejection of the proposal.

1.13 Minimum Insulation of Equipment

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

1.14 Nameplate Information

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

- Name of manufacturer and country
- Type, design, and serial number
- Rated voltage and current
- Rated frequency
- Rated symmetrical breaking capacity
- Rated making capacity
- Rated short time current and its duration
- Rated lightning impulse withstand voltage
- Purchase Order number and date
- Month and year of supply
- Property label: Property of WBSEDCL
- Guarantee period : 5 years

1.15 Danger Board:

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

1.16 Interconnecting Cables, Wiring, Connectors, and Terminal Blocks

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

1.16.1 Cables

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

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

The DC cables from the battery unit to RMU and to pilot marshalling box shall be at least $4mm^2$. CT & OT Control cable will be 2.5 Sq. mm and all other control cable shall be 1.5 mm^2 Cu multi-conductor and shall be screened with half-lapped copper tape. All wiring and termination of connecting cables shall be carried out by the bidder. Conductor used for AC and DC circuits shall not be mixed in the same multi-conductor cable.

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

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

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

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

1.16.2 Connectors

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

1.16.3 Terminal Blocks

Suitable Disconnector type terminal blocks shall be provided for CT circuits with necessary spares with 5 mm minimum machine screws shall be provided by the Contractor for other necessary metallic cable terminations. In using a terminal block, no more than two cables or wires shall be connected to any of its individual terminals.

Self-extinguishing fireproof vinyl marking strips shall be used to identify all external connection blocks. Marking tags shall be read horizontally. All terminals to which battery or other high voltages are connected shall be provided with fireproof covers.

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

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

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

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

1.17 General Requirements

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

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

- Positions of local/remote switches as used to control local and remote access to circuit breakers.
- Power supply indications including battery failure and voltage alarms.
- Open/closed position of circuit breakers, and earthing switches.
- Enclosure door-open indications.
- SF_6 gas-pressure low alarm and Lockout.
- Isolator/Circuit breaker spring charge indications.
- Circuit breaker relay protection indications.
- Circuit breaker open/close control.
- Protection device failures through built-in Watch dog contact i.e 'self monitoring' feature of relay. This indication can be wired to RTU for integration in SCADA.
- FPI indication

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

1.17.1 Design Details

- The RMU shall be designed to operate at the rated voltage of 12 kV. It shall consist of two (2) numbers of 630 Amps SF_6 insulated Isolators (incomers) and up to one (1) number of 200 Amp SF_6 insulated Circuit Breakers for load.

- It shall include, within the same metal enclosure, earthing switches for each Isolators and Circuit Breaker.

- Suitable full-proof interlocks shall be provided to the earthing switches to prevent inadvertent or accidental closing when the circuit is live and the concerned Circuit Breaker/Isolator is in its closed position.

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

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

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

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

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

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

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

- The design shall incorporate features that prevent any accidental opening of the earth switch when it is in the closed position. Similarly, accidental closing of a Circuit Breaker shall be prevented when the same is in an open position. This includes protection against accidental closing resulting from the release of any latch or spring in tension due to vibrations caused externally or internally.

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

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

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

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

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

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

- The maximum allowable Dimension of 3 way SCADA compatible Non – Extendable RMU will be – Length – 1800mm, Breadth – 1000mm & Height – 2300 mm.

1.19.2 Sulphur Hexa Fluoride Gas (SF6 GAS):

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

1.20 ENCLOSURE:

All Bidder-supplied enclosures shall be sized to provide convenient access to all enclosed components. It shall not be necessary to remove any component to gain access to another component for maintenance purposes or any other reason.

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

1.20.1 Outer Enclosure:

The RMU enclosure (Outer) shall be made up of CRCA steel of minimum 1.6 mm thickness. The rating of enclosure shall be suitable for operation on three phase, three wire, 12 kV, 50 cycles, A.C. System with short-time current rating of 18.4KA for 3 seconds for 12 kV supply with Panels. The complete RMU enclosure shall be of degree of protection **IP 54**. The

enclosure shall provide full insulation, making the Switchgear insensitive to the environment like temporary flooding, high humidity etc. The active parts of the Switchgear shall be maintenance-free and the unit shall be of minimum maintenance.

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

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

The Switchgear and Switchboards shall be designed such that the position of the different devices is visible to the operator on the front of the Switchboard and operations are visible. In accordance with the standards in effect, the switchboards shall be designed so as to prevent access to all live parts during operation without the use of tools.

1.20.2 Inner enclosure (Main tank)

The tank shall be preferably made of time tested welded stainless steel sheet of adequate thickness to ensure leak rate less tank 0.1% per year. The tank shall be sealed and no handling of gas is required throughout the service life. However, the SF6 gas pressure inside the tank shall be at 1.3 bar relative minimum to ensure the insulation and breaking functions and constantly monitored by a temperature compensating gas pressure indicator offering a simple go, no-go indication. The gas pressure indicator shall be provided with green pressure and red pressure zones. There shall be one Non – return valve to fill up the gas. The manufacturer shall give guarantee for maximum leakage rate of SF6 gas will be lower than 0.1 % / year. An absorption material such as activated alumina in the tank shall be provided to absorb the moisture from the SF6 gas to regenerate the SF6 gas following arc interruption. The degree of protection of the inner enclosure shall be IP 67.

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

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

1.21 Earthing

- There shall be continuity between metallic parts of the RMUs and cables so that there is no dangerous electric field in the surrounding air and the safety of personnel is ensured.
- The RMU frames shall be connected to the main earth bars, and the cables shall be earthed by an Earthing Switch having the specified short circuit making capacity.
- The Earthing Switch shall be operable only when the main switch is open. In this respect, a suitable mechanical fail-proof interlock shall be provided.

- The Earthing Switch shall be provided with a reliable earthing terminal for connection to an earthing conductor having a clamping screw suitable for the specified earth fault conditions. The connection point shall be marked with the earth symbol.

- The Earthing Switch shall be fitted with its own operating mechanism. In this respect, manual closing shall be driven by a fast acting mechanism independent of the operator's action.

- All parts of the switchgear metal enclosure, relay and instrument cases, cable glands, earthing terminals and other metal work on switchgear shall be connected to earth by means of main and subsidiary earth bus bars.

- The switchgear earth bar and earth conductors shall be of high conductivity copper and their sizes shall be selected in accordance with BS CP 1013 taking into consideration the rated short circuit currents of the switchgear.

- All metal parts of the switchgear which do not belong to main circuit and which can collect electric charges causing dangerous effect shall be connected to the earthing conductor made of copper having cross section area of minimum 90 sq.mm. Each end of conductor shall be terminated by M12/equivalent quality and type of terminal for connection to earth system installation. Earth conductor location shall not obstruct access to cable terminations.

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

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

1.22 Circuit Breakers

The Circuit Breakers shall be maintenance free and, when standing in front of the RMU with enclosure doors open, their positions shall be clearly visible. The position indicator shall provide positive contact indication in accordance with IS 9920. In addition, the manufacturer shall prove the reliability of indication in accordance with IS 9921.

The breakers shall have three positions (or states), i.e., Open, Closed, and Earthed, and shall be constructed in such a way that natural interlocking prevents unauthorized operations. They shall be fully assembled, tested, and inspected in the factory.

An operating mechanism shall be used to manually close the Circuit Breaker and charge the mechanism in a single movement. It shall be fitted with a local system for manual tripping.. The Circuit Breaker shall be capable of closing fully and latching against the rated making current. Mechanical indication of the OPEN, CLOSED, and EARTHED positions of the Circuit Breaker shall be provided.

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

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

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

1.23 **RING SWITCHES (Isolator)**:

They shall consist of 630 amp fault making/load breaking spring assisted ring switches, each with integral fault making/load breaking earth switches. The switch shall be naturally interlocked to prevent the main and earth switch being switched 'ON' at the same time. The selection of the main and earth switch is made by a lever on the fascia which is allowed to move only if the main or earth switch is in 'OFF' position. **The Ring switches shall be capable for remote SCADA operation.**

1.24 BUSBARS:

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

1.25 BUSHINGS

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

1.26 CABLE BOXES

All cable boxes shall be air insulated suitable for dry type cable terminations. The cable boxes of the circuit breaker shall be suitable up to **12 kV 3C x 400/300 sq.mm XLPE** types vertically ascending cable preferably for front type connection. Necessary Right angle Boot should be supplied for cable terminations. Compound filled cable boxes are not acceptable. The cable box shall be arc resistant as per IEC 62271-200 amended upto date. The internal arc fault test on cable box shall be carried out for 12 kV systems for 18.4 kA for 1 second. The clearance between phase to phase and phase to earth shall be as per IEC 61243 – 5

amended upto date. The cable box provided shall be of adequate dimension to house an air-insulated cable termination. It shall be able to accommodate crossing of phase cores, if necessary. The cable box shall be rated in accordance with the rated insulation level of the switchgear.

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

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

1.27 VOLTAGE INDICATOR LAMPS AND PHASE COMPARATORS

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

1.28 Operating lever

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

1.29 Safety of Equipment

With respect to the RMU's SF_6-filled equipment, any accidental overpressure inside the sealed chamber shall be limited by the opening of a pressure-limiting device in the enclosure so that the gas will be released away from the operator without endangering the operator or anyone else in the vicinity of the RMU.

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

1.30 Front Plate

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

1.31 Current Transformers/Sensors

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

The CTs shall conform to IS 2705. The design and construction shall be sufficiently robust to withstand thermal and dynamic stresses during short circuits. Secondary terminals of CTs shall be brought out suitably to a terminal block, which will be easily accessible for testing and terminal connections.

Further characteristics and features for CT used for protection are listed as follows:

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

- Material: Epoxy resin cast
- Ratio and burden suitable as per FPI manufacturer's recommendation.

CTs for Protection (for Outgoing) :

- Material: Epoxy resin cast
- Burden: 2.5VA
- Ratio: 100-50/1 A
- Accuracy Class: 5 P 5
- If current measurement & communication of measured data through MODBUS protocol is done by the relay, no need for metering core.

1.32 Protection Relay

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

1.33.1 General

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

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

- Phase Over current Protection: Non-directional (50/51)
- Earth Fault Protection : Non-Directional (50N/51N)
- Transformer supervision- Bucholtz alarm/trip (applicable for oil cooled DTR), temperature alarm etc. for 630kVA ONAN Transformer and above.

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

1.33.2 Features and Characteristics

The numerical relay shall have the following minimal features and characteristics noting that variations may be acceptable as long as they provide similar or better functionality and/or flexibility:

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

The bidders will have to send the numerical relay of same make, model, Firmware & type as offered in the bid documents along with Engineers to Distribution Testing Department on the prescheduled date & time for testing of the relay in respect of relevant features as per specification and Communications via a MODBUS RS232/RS485 port to provide the RTU (and hence the SCADA) with phase current measurements and tripping indications.. The bidder will have to provide the necessary software for testing of the communication part. This is a part of Techno-commercial evaluation and it is the responsibility of the bidder to show all the features of the relay, failing which they will not be considered as Techno-commercially acceptable. The date & time of such tests at Distribution Testing Department, WBSEDCL, will be intimated to the bidder at least 10 (Ten) days prior to the date of testing. The particular relay thus tested will have to be supplied during execution of the Order if placed upon them.

- It shall be housed in a flush mounting case and if required, will be powered by the RMU power supply unit.
- It shall have three phase over current elements and one earth fault element.
- IDMT trip current settings shall be 20-200% in steps of 1% for phase over current and 10-80% in steps of 1% for earth fault.
- Instantaneous trip current settings shall be 100-3000% in steps of 100% for phase over current and 100-1200% in steps of 100% for earth fault.
- Selectable IDMT curves shall be provided to include, for example, Normal Inverse, Very Inverse, Extreme Inverse, Long Time Inverse, and Definite Time. Separate curve settings for phase over current and earth fault shall be supported.
- For IDMT delay multiplication, the Time Multiplier Setting (TMS) shall be adjustable from .01 to 0.1 in 0.1 steps.
- The relay shall have local independent LED indications for Healthy, Trip, I>, I>>, IN>, and IN>> conditions.
- The relay shall also be provided with:
  - Alphanumeric Liquid Crystal Display (LCD) for measurement and relay setting.
  - Communications via a MODBUS RS232/RS485 port to provide the RTU (and hence the SCADA) with phase current measurements. It is also desirable that this same means of communication can be used by the RTU to send setting.
  - Front USB port for local communications with a laptop PC.
  - Parameter change capability that is password protected.
  - Capability to record up to 5 of the latest fault records duly time stamped and stored in non-volatile memory for subsequent reading via the above referenced USB port.

1.34 Power Supply

Each RMU shall be outfitted with a power supply, including batteries and battery charger, suitable for operation of a 4-way RMU even if the RMU is only 3-way. The following operational specifications shall apply:

- The power supply unit shall conform to the following requirements:

- Input: 230 V AC nominal from the RMU's auxiliary power transformer allowing for possible variations from 190 to 300 V AC
- Output: Stable 24 V DC
- Batteries: 24 V DC
- **Receptacles: 2 x 230 V AC (for test equipment)**
- Lighting Fixtures: One for each enclosure

- The auxiliary power transformer's inputs shall be equipped with surge protection devices in accordance with IEC 62305.
- The 24 V DC batteries shall have sufficient capacity to supply power to the following devices with a nominal backup of 8 hours:
  - To restore a depleted battery to 80% of full capacity in less than 8 hours.
  - To deliver the load of RMU's trip coils, close coils, multifunction meters, and relays, spring charge motor.
- The batteries shall be of sealed lead acid or Ni-Cad type, comply with IEC 60623 and shall have a minimum life of five (5) years. The nominal capacity in ampere-hours shall be the capacity for five hour discharge (C_5). The cell shall be of a suitable type for high rate/medium rate discharge (3C5 to 7C5). A cell of low rate of discharge is not acceptable. Each battery cell (For Lead Acid Cell) shall come with a transparent housing for the ease of checking of the battery water level. The battery shall have the capability to close and open the switches for at least 10 close-open cycles (this must be verified by calculation). When sizing the AH capacity of the battery, the effect of aging shall be taken into consideration. The AH rating of the battery shall be greater than calculated AH but not less than 20AH.
- The battery charger shall be fully temperature compensated.
- To prevent deep discharge of the batteries on loss of AC power source, the battery charger shall automatically disconnect all circuitry fed by the batteries following a user-adjustable time period or when the battery voltage falls below a preset value.
- The battery charger shall be provided with an alarm displayed at the local control panel and remotely at the SCADA to account for any of the following conditions:
  - **Low battery voltage**
  - **High battery voltage**
  - **Battery failed**
  - **Battery charger overvoltage**
  - **Grounded battery/battery-charger**
  - **Low electrolyte alarm**
  - **Input MCB off**
  - **Station AC supply fail**
  - **Battery Charger fail**
  - **Others according to manufacturer's design**

- **The capacity of battery and charger and the basis of calculation shall be declared in the GTP.**

1.35.1 Battery Charger

The charger shall be designed to provide a well regulated DC supply to the load while float charging or quick charging the battery. The charger shall be the constant potential, current limiting fully automatic type. The charger shall automatically switch to float charge after the battery is restored to 80% of its nominal capacity under BOOST charge. The BOOST charge shall be automatically ON after an emergency discharge and the duration of BOOST charge shall be less than 8 hours.

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

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

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

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

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

1.36 Distribution Automation System Interface

The RMU shall be equipped so that it can be monitored and controlled via the SCADA. In this respect, it shall interoperate with the RTU that will be housed in the RMU Control Cabinet. The RTU in turn will interoperate with the SCADA through public network of GPRS/CDMA. The RMU shall have provisions for opening and closing its switches, breakers using output from the RTU. The RMU shall also supply analog and status signals to the RTU for monitoring the condition of the RMU's distribution network circuits as well as the components of the RMU. A list of input/output points required for 3-way is presented in Table 1-2 below. Digital Input points and control Output points shall be connected via auxiliary relay to be provided by SCADA Vendor and analog value and protection alarms shall be provided via IED/Relay through MODBUS through RS-485 ports.

Table 1-2: Data Points per RMU Configuration

3-Way RMU

DIGITAL INPUT	CONTROL OUTPUT	Numerical Relay
Isolator1 ▪ closed ▪ open ▪ Spring 1: charged ▪ Earth switch 1: closed ▪ Earth switch 1: open ▪ local/remote status ▪ Door: open ▪ FPI O/C, E/F indication Isolator2 ▪ closed ▪ open ▪ Spring 1: charged ▪ Earth switch 1: closed ▪ Earth switch 1: open ▪ local/remote status ▪ Door: open ▪ FPI O/C, E/F indication CB(Tee off) 1 ▪ closed ▪ open ▪ Spring 1: charged ▪ Earth switch 1: closed ▪ Earth switch 1: open ▪ local/remote status ▪ Door: open Miscellaneus ▪ SF_6 Pressure: Low ▪ Charger AC: Fail ▪ Voltage DC: Low Battery alarms: Battery-failed, etc.	Isolator 1 ▪ Close and Open Isolator 2 ▪ Open and Close CB 1 ▪ Open and Close	Communication on MODBUS through RS-485 ports Measurement Points: ▪ Current ▪ Over Current ▪ Earth Fault

1.37.1 Numerical Relay Interface with RTU

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

1.38 Construction

The RMU shall be sufficiently sturdy to withstand handling during shipment, installation, and start-up without damage. The configuration for shipment shall adequately protect the RMU equipment from scraping, banging, or any other damage. The Bidder shall assume responsibility for correction of all such damage prior to final acceptance of the equipment.

1.39 Control Cabinet

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

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

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

The cabinet shall have a hinged front access door with a three-point latch locking system and a latch operating lockable handle. The door shall be fitted with a perimeter flange and gasket (rubber or neoprene) to prevent the entrance of water. **In addition, a means of monitoring and indicating that the door is open shall be provided.**

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

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

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

1.40 **Auxiliary Transformer**

The RMU shall be outfitted with a single-phase auxiliary power transformer with a turns ratio of 11000/sq rt (3) to 230, i.e., it shall be connected line-to-neutral to the RMU 11 kV bus and used to provide the required 230 VAC input to the RMU's power supply. The auxiliary power transformer shall have a capacity of at least 1.0 KVA. During supply, however, the supplier shall assess this requirement by taking into account the actual load corresponding to the RTU and Modem (supplied by others) as well as the load represented by the RMU motors, etc. In this respect, with a suitable margin approved by the Employer, the auxiliary transformer must be capable of supporting the power supply requirements that correspond to a 4-way RMU. HRC fuses shall be provided on both the HV and LV sides of the transformer.

1.41 Motors

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

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

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

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

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

1.42 Operating Mechanism:

1.42.1 Manual Operation:

The Circuit Breaker shall be provided with an independent manual closing and opening mechanisms complete with operating handles. An approved visual indicating device coupled to the operating mechanism shall be provided to show whether the breaker is open or close. The operating mechanism shall be of robust construction and shall be designed to operate with minimum mechanical shock and to prevent inadvertent operation due to vibration or other causes. The circuit breaker shall be operated from the front of the equipment.

1.42.2 Motorised Operation:

The circuit breaker/Isolators shall in addition be provided with motor actuator to enable them to be remotely operated. If the actuator mechanism is to be detached before manual

operation is possible, simple means of detaching the mechanism shall be provided. Padlockable cover shall be provided over the actuator and its linkages.

1.43 Fault Passage Indicator (FPI)

This shall facilitate quick detection of faulty cable. The fault indication may be on the basis of monitoring fault current through the device. The unit shall be self contained requiring no auxiliary supply. FPI shall be integral part of each Isolator and shall be capable of displaying fault. It shall have LCD/LED display and electrical reset facility. It shall sense short circuit and earth fault current separately. It shall have multiple ampere and time setting both for short circuit and earth fault. The FPI should be put through current sensor with site selectable setting/CBCT in all the three phases of the Ring of the RMUs. FPI should have suitable connectivity with the FRTUs for the SCADA purpose for remote reset.

1.44 Integral Cable Earthing Switch

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

1.45 Cable Testing and Test Plug

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

1.46 Indicators

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

A single line diagram and mimic system of the RMUs, indicating the layout and connection of the Circuit Breakers and bus-bars shall be provided at the front of the equipment. Positively driven mechanical indication of the operating positions of a switching device shall be provided. Separate labels shall indicate ON, OFF and EARTH ON for the Circuit breakers. Separate labels shall indicate MAIN SWITCH and EARTH SWITCH for breakers and earth switch mechanism.

1.47 Interlocks

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

The interlocks shall be by mechanical means only.

The following minimum interlocks to prevent:-

i. Inadvertent operation of the Circuit breaker from ON to EARTH position.

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

iii. Earthing of cable when Circuit Breaker is in ON position.

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

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

1.48 SF_6 Gas Pressure Gauge

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

1.49 Padlocks

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

1.50 Provision of Supervisory Control

1.51.1 Control Circuits of RMU

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

1.51.2 Position indication of Circuit breaker

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

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

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

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

1.52 TYPE and ROUTINE TEST:

1.52.1 Type tests:

The equipment offered in the tender should have been successfully type tested at NABL laboratories in India or equivalent international laboratories in line with the relevant standard and technical specification, within the last 5 (five) years from the date of offer. The bidder shall be required to submit complete set of the type test reports along with the offer.

The list of type tests is as follows:

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

II. Lightning Impulse voltage with-stand test.

III. Temperature rise test.

IV. Short Circuit current making and breaking tests.

V. Power frequency voltage withstand test (dry).

VI. Capacitive current switching test conforming to IEC.

VII. Mechanical operation test.

VIII. Measurement of the resistance of the main circuit.

IX. Degree of protection of main tank and outer enclosure.

X. Circuit breaker, earthing switch making capacity.

XI. Switch, circuit breaker breaking capacity.

XII. Internal arc withstand.

The details of type test certificate according to the composition of the Switchboard shall be submitted with the offer. In addition, for switches, test reports on rated breaking and making capacity shall be supplied. For earthing switches, test reports on making capacity, short-time withstand current and peak short-circuit current shall be supplied.

1.52.2 ACCEPTANCE & ROUTINE TESTS:

All acceptance as stipulated in the respective applicable standards amended up-to-date for all the equipment shall be carried out by the supplier in the presence of purchaser's representative without any extra cost to the purchaser before despatch.
The tenderer shall have full facilities to carry out all the acceptance and routine test as per the applicable standards.

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

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

The routine tests are as follows:

1. Conformity with drawings and diagrams,
2. Measurement of closing and opening speeds,
3. Measurement of operating torque,
4. Checking of filling pressure,
5. Checking of gas-tightness,
6. Dielectric testing and main circuit resistance measurement.
7. Power frequency voltage
8. Resistance test for the circuit
9. Mechanical operation tests.
10. Checking of Partial Discharge on complete unit.

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

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

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

1.53 INSPECTION:

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

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

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

1.54 MANUFACTURING FACILITIES:

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

1. Robotic/Tig welding station for stainless steel main tank ensuring the leak rate less than 0.1% per annum
2. Work stations with adjustable work benches and torque wrenches, giving flexibility to workmen for proper tightness of internal components of sealed tank.
3. State of the Gas leak testing system ensuring the quality of sealing and have precision to measure leak rate less than 0.1% per annum.
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. Computerized SF6 filling and testing facility.
7. Partial Discharge Lab for conducting the partial discharge test.
   It is mandatory to have the complete assembled tank tested for partial discharge to ensure a high life and reliability of the product.

1.55 QUALITY ASSURANCE PLAN:

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

1.56 DRAWINGS:

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

1. Schematic diagram of the RMU panel
2. Instruction manuals
3. Catalogues of spares recommended with drawing to indicate each items of spares
4. List of spares and special tools recommended by the supplier.
5. Drawings of equipments, relays, control wiring circuit, etc.
6. Foundation drawings of RMU.
7. Dimensional drawings of each material used for item Vii.
8. Actual single line diagram of RMU/RMUs with or without extra combinations shall be made displayed on the front portion of the RMU so as to carry out the operations easily.

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

1.57 PACKING & FORWARDING:

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

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

a. Name of the consignee.
b. Details of consignment.
c. Destination.
d. Total weight of consignment.
e. Sign showing upper/lower side of the crate.
f. Handling and unpacking instructions.
g. Bill of material indicating contents of each package.

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

1.58 PERFORMANCE GUARANTEE:

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

1.59 DOCUMENTATION:

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

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

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

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

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

1.60 SCHEDULES:

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

Schedule 'A' ... Guaranteed technical particulars.

Schedule 'B' ... Schedule of Tenderer's experience.

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

1.61 The bidders are required to offer numerical relays and some accessories as per list shown in Annexure -'A'

1.62 ACCESSORIES & SPARES:

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

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

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

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Annexure – 'A'

Standard make of Relay & some Accessories are as follows:

Sl. no.	Description of Accessories	Maker's Name
1	Relays	ABB., Siemens, Schneider Electric, C&S, CGL
2.	Breaker Control Switch	Kaycee/Alstom/Recom
3	Ammeter/Voltmeter Selector Switch	Kaycee/Alstom
4	Static Ammeter/Voltmeter	AE/IMP/MECO
5.	Push Buttons	Alstom/Kaycee/Vaishnu
6.	Indicating Lamp with Lenses	Alstom/Kaycee/Vaishno
7	Panel Wiring	ECKO/PHOENIX
8.	Vacuum Interrupter	CGL/BEL/SCHNEIDER/SIEMENS/ABB / or OEM make
9.	FPI	Preferably of OEM make

Schedule-A

GUARANTEED TECHNICAL PARTICULARS FOR OUTDOOR RMU
PART 1

01.	Manufacturer's Name and Country of origin	
02.	Manufacturer's Design/Type/Model	
03.	Material used for making the body of the RMU	
04.	Standards of manufacturing	
05.	Whether painting for RMU is done as per standards	
06.	Whether the enclosure is anti-corrosive	
07.	Whether RMU metal clad has sufficient space for integration of: ▪ 1 number of Vacuum Circuit breaker ▪ Sufficient space for inspection, testing, etc. ▪ Earthing arrangements ▪ Terminal output points for automation ▪ Sufficient arrangement for future extension with Circuit Breakers	
08.	Maximum withstanding ambient temperatures	
09.	Spacing between live parts to earth	
10.	Whether RMU are designed to withstand all weather conditions including chemical industry and polluted areas	
11.	Period of guarantee of the RMU	
12.	Over all dimensions of the RMU (L x W x H). Maximum allowable – L – 1800mm, W – 1000mm & H – 2300mm	
13.	Material & Gauge of material used for fabrication of the RMU	
14.	Whether RMU is manufactured as per IEC/IS standards to hold SF6 gas without leakage	
15.	Whether RMU has provision for sensors for temperature compensated pressure measurement in the relevant gas compartment to monitor the pressure of SF6 gas	
16.	Whether RMU is sealed pressure system	
17.	Weight of RMU complete with operating mechanism	
18.	RMU is provided with necessary take off terminals for automation	

19.	Whether gas chamber is made of stainless steel	

SCHEDULE OF GUARANTEED PARTICULARS FOR BREAKER
PART 2

01.	Manufacturer's Name and Country of origin	
02.	Manufacturer's Design / Type ref/ Model.	
03.	Material used for making the body of the breaker	
04.	Standards of manufacturing	
05.	Whether the breaker is manufactured as per IEC/IS standards Please give Standards no.	
06.	Maximum temperature withstand of the breakers	
07.	1) Spacing between live part to Earth inside the breaker 2) Spacing between poles	
08.	Period of guarantee of the breaker	
09.	Rated frequency	
10.	Rated voltage	
11.	Highest system voltage	
12.	Rated current	
13.	Short time current rating with duration	
14.	Certificate or report of short circuit type test	
15.	Rated operating duty cycle	
16.	Short circuit breaking current (a) Symmetrical (b) Symmetrical at rated voltage (c) Asymmetrical at rated voltage (i) Per Phase (ii) Average (d) DC Component	
17.	Arcing time (At rated breaking current) in ms.	
18.	Opening time	
19.	Total break time in mili sec. (a) At 10% rated interrupting capacity (b) At rated interrupting capacity	
20.	Breaking Current (a) Rated out of phase current (b) Rated cable charging current (c) Rated fault level MVA (d) Rated capacitor breaking current	
21.	Make time in ms.	
22.	Maximum temperature rise over ambient (a)Main contacts Terminals	
23.	Rated restriping voltage at 100% and 50% rated capacity. (a)Amplitude factor	

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

SCHEDULE OF GUARANTEED PARTICULARS FOR EARTHING SWITCHERS
PART 3

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

SCHEDULE OF GUARANTEED PARTICULARS FOR CURRENT TRANSFORMERS
PART 4

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

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

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

SCHEDULE 'B'

SCHEDULE OF TENDERER's EXPERIENCE

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

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

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

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

DESIGNATION----------

DATE----------
