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# SUPPLY CHAIN MANAGEMENT

## THIRUVANANTHAPURAM

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### SPECIFICATION

#### 11KV INDOOR VCB PANELS

<b>APPLICABLE TO KSEBL</b>	<b>Rev#0</b>	<b>DOC. NO.: SCM-SPEC/XT/11KV INDOOR VCB PANEL</b>
		<b>EFF. DATE: 31/05/2021</b>

Number of Pages: 76

**Technical Specification and Evaluation Committee for Transmission Material**



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Effective Date 31/05/2021

**(i) Document Approval & Control Status**

	<b>Compiled by</b>	<b>Verified by</b>	<b>Approved by</b>
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Date	11/05/2021	14/05/2021	28/05/2021
Signature	<b>Sd/-</b>	<b>Sd/-</b>	<b>Sd/-</b>

**(ii) Amendments and History**

<b>Sec. #</b>	<b>Rev. #</b>	<b>Date</b>	<b>History of Change</b>



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**1. Purpose:**

Purpose of this document is to document updates & history, upkeep and publish the specifications related to **11kV Indoor VCB Panel** in a professional manner

**2. Scope:**

The Scope of this document is to inform and alert all relevant stakeholders including KSEBL. Public, KSERC etc regarding the current specifications and historical changes adopted in specifications of **11kV Indoor VCB Panel** used in field by KSEBL

**3. Responsibility:**

**The Executive Engineer (T), Office of Chief Engineer, Supply Chain Management** shall compile and take necessary steps to publish the specification in KSEBL website and shall inform relevant stakeholders regarding updates and revisions

**4. Procedure For Revision:**

Modifications if any, in the technical specification will be incorporated as **Revisions**. Any changes in values, minor corrections in pages, incorporation of small details etc. will be considered as Minor Modification. **The Revisions due to minor modifications will be assigned as Rev. No.0.1, 0.2 etc.**

A complete updation of the technical specification will be considered as Major modification. **The Revisions due to major modifications will be assigned as Rev. No.1.0, 2.0 etc.**

All the details of regarding the revisions (both minor and major) will be incorporated in **“(ii)-Amendments and history”** above.

The concerned officers, in consultation with the Technical Committee will review and suggest changes required and the revision suggestion will be approved by **Chief Engineer (SCM)**. Those who notice any discrepancy or have any suggestion regarding revision, may bring the matter to the attention of Chief Engineer (SCM) in writing or through e-mail id: [cescm@kseb.in](mailto:cescm@kseb.in)



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**TECHNICAL SPECIFICATIONS AND CONSTRUCTIONAL FEATURES OF 11 KV INDOOR VCB SWITCH GEAR PANEL**

**1) SCOPE**

- 1.1.** The specification covers the design, documentation, engineering, manufacture, inspection and testing at suppliers works, packing and delivery at consignee address , loading & unloading ,support for commissioning, **if required** and after sales support for **11 kV Indoor VCB Panel set with various combinations of Incomer Feeder Panels, Outgoing Feeder Panels, Bus Coupler Panels with Bus Riser Panels with supply of accessories necessary for operation and spares, to be installed at various sub stations of KSEBL. Bus Bar Ratings are 2000A or 1250A as per Schedule of Requirement (Part-I – Section E- Format -D). Items shall be engineered with necessary wiring and arrangements and so that each panel shall be assembled to meet the station wise requirement as per schedule of requirement. The final Panel assembly meant for each station shall have provision for adding one more panel at each end, if required in future.**
- 1.2.** The equipment to be supplied against this specification is required for vital installations where continuity of service is very important. The design, materials and manufacture of the equipment shall therefore, be of highest order to ensure continuous and trouble free service over the years.
- 1.3.** The manufacturer has to design the schematic for protection and control of all equipments including monitoring indications, visual and audible alarm, interlocking schemes among different equipments.
- 1.4.** Any other requirement which are not specifically covered here but necessary for successful operation and commissioning of the equipment are also within the scope of the contract.

**2) STANDARDS**

- 2.1** Material, equipment and methods used in the manufacture of switchboard shall conform to the latest edition of following.

<b>Standard Name / No.</b>	<b>Standard's Description</b>
IEC: 62271-1, EC: 62271-3, IEC: 60298, IEC: 62271-200, IEC: 60529. IS: 3427, IS 12729, IS 12063, IS:13947, IS: 9046, IS: 3427/69	Switchgear and control gear



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IEC:60298	Ac metal enclosed switchgear/ control gear for rated voltage above 1kV upto including 72.5kV
IEC 62271-100, IS 13118	HV AC Circuit Breaker
IEC 60947	Low Voltage Switchgear and Control gear
IS/IEC 60529	Degrees of protection provided for enclosures
IS :6005	Code of practice for phosphating iron and steel
IS :5	Colours for ready mixed paints and enamels
IS: 694	PVC insulated cables up to and including 1100V
IS:5578/1984	Guide for uniform system of marking and identification of conductors and apparatus terminals.
IS:11954	Guide for colour coding of Electrical Mimic Diagram
IS:1248 & IS:2419	Indicating Instruments
IS13947 (Part 5/ Sec 1) 2004	Control Switches
IS13947 (Part 5/ Sec 1) 2004	Push Buttons
IS 14697	HT Static Tri vector TOD Energy Meter
IS:9224(part II)	HRC Cartridge fuse links
IS:3842	Application guide for protection
IS:3231, IEC 61000, IEC 60068, IEC 60529, IEC 61010-1	Electrical relays for power system protection
IS:8686	Static Protective Relays
IEC 60255	Numerical Relays
IEC 61850	Communication Networks and Systems in Sub Station
IEC 6100-4-29	DC Voltage dips and interruptions/ variations
IS 2705,IEC:60185	Current Transformer



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IS 3156 , IEC:60186	Voltage Transformer
IS 3072	Code of practice for installation and maintenance of switchgear
IS 375, BS: 159/67	Arrangement of switchgear bus bars, main connection and auxiliary wiring
IS 9385	HV Fuses

Equipment complying with other internationally recognized standards will also be considered subject to approval of KSEBL if it ensures performance equivalent or superior to above mentioned standards.

- 2.2. In the event of supply of equipment conforming to any international/internationally recognized standards other than standards listed above, the salient features of comparison shall be brought out and furnished along with the bid. One copy of such standard specification in English language shall be enclosed with the tender without any additional cost.
- 2.3. The equipment provided shall also comply with latest revisions of Indian Electricity Act , CEA Guidelines and any other applicable statutory provisions, rules and regulations.

### 3) CLIMATIC CONDITIONS

- 3.1 The climatic conditions at site under which the equipment shall operate satisfactorily are as follows.

Maximum ambient air temperature	50 <sup>0</sup> C
Maximum ambient air temperature in shade	40 <sup>0</sup> C
Minimum ambient temperature in shade	17 <sup>0</sup> C
Maximum Relative humidity	100%
Average annual rainfall	3000mm
Average number of rainy days per annum	130
Maximum wind pressure	100Kg/sq.m
Climatic Condition:	Moderately hot and humid tropical climate conducive to rust and fungus growth





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- 3.2. The climatic conditions are prone to wide variations in ambient conditions and hence the equipment shall be of suitable design to work satisfactorily under these conditions.
- 3.3 For the purpose of this specification, the reference ambient temperature would be 40°C

**4) SYSTEM DATA**

Frequency	:	50 Hz
Nominal System Voltage	:	11 kV
Highest System Voltage	:	12 kV
Rated short time current	:	25 kA for 3 seconds
Power frequency withstand voltage	:	28 kV
Basic insulation level	:	75 kVp
System Neutral	:	Solidly earthed.
Control Supply	:	110 V DC

**5) REQUIREMENT**

- 5.1. Schedule of requirement is given in **Part I - Section E - Format (D)**
- 5.2. The panels are to be arranged station wise as per **Format (D)** attached and interpanel wiring to be done accordingly. The Schematic drawing to be provided for each panel set along with the inter panel wiring and Terminal Schedule.
- 5.3. The PT Selection Scheme to be designed in accordance with the Panel set descriptions mentioned in the **Format (D)** When Panel sets are intended to be used in the existing stations the PT Selection Scheme to be designed to use with existing scheme.
- 5.4 **EQUIPMENT TYPE:-**The switchgear shall be self standing air insulated and fully metal clad. The circuit breakers shall be of vacuum draw-out type, arranged for vertical or horizontal isolation of the drawn- out breaker. The switchgear shall be suitable for indoor installation. They shall be of robust construction and dust and vermin proof. Panel should be provided with 3 insulated bus bars and shall have facility for extension by adding individual cubicles at either end. **The circuit breaker for outgoing feeder panels shall be interchangeable. Circuit Breaker truck shall have 'Rack in/out' facility without opening of the doors.**

**The equipment shall comply Internal ARC Class IAC AFLR 25kA/1Sec and the Circuit Breaker shall be E2 M2 C2 Class as per IEC 62271-200.**



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**6) RATING**

**6.1.** The complete switchgear equipments shall be designed for operation at normal system voltage of 11000 volts between phases and shall be capable of carrying a short time current equivalent to the symmetrical short circuit breaking capacity of not less than 500 MVA.

**6.2.** Temperature Rise:- Current carrying component of equipment shall be capable of continuous operation with a specified/ IEC rating without exceeding the maximum temperature rise mentioned in the appropriate IEC Standards at ambient temperature not exceeding 40°C.

**6.3.** The ratings of circuit breakers, current transformers, potential transformers and bus bars are given below.

**a) CIRCUIT BREAKERS:-**

Number of poles	: 3
Frequency	: 50 Hz
Nominal System Voltage	: 11 kV
Highest System Voltage	: 12 kV
Rated current for Incomer & Bus Coupler	: 1250 A for Trfr up to 16 MVA : 2000A for Trfr 16 MVA & 20MVA
Rated current for Outgoing & Aux Trfr	: 630A
Minimum Interrupting capacity	: 500 MVA
Rated short time current	: 25kA for 3 seconds
Power frequency withstand voltage	: 28 kV
Basic insulation level	: 75 kVp
Duty Cycle	: O-0.3s-CO-3min-CO
Spring Charging Motor Supply	: 230V AC

**b) CURRENT TRANSFORMERS:-** The current transformers shall have sufficient rating and shall be suitable for the instruments, protection relays etc. used in the equipment. Separate current transformers shall be used for metering and protection or alternatively CTs with multiple secondary cores may be used. Resin cast CTs with class E insulation or better shall be preferred. **The CT secondary terminals shall be easily accessible for testing by removing the bolted back door.** The heavy duty terminal strips for CTs shall be provided with isolating links for testing without disconnecting cables.



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**One number outdoor type neutral current transformer for REF protection, to be supplied with each of incomer panel.** Cables from Neutral CT for REF protection for **inter trip connections**, Cable from CTs for Differential Protection, DC, AC inputs etc shall be brought to a terminal box on the back side of Incomer feeder panels, with 20% spare terminals.

Better visibility and easy access to secondary terminals and sufficient clearance of secondary leads from HT parts needs to be ensured through proper routing of secondary wiring, while designing cable entry and CT chamber, in order to avoid chances of the failure of differential relay due to flash over of CT secondary wires.

The Ratio, VA rating, accuracy limit factors etc. of the CT shall be suitable for the instruments, relays and other equipments used in the panel as given below:

**CURRENT TRANSFORMERS**

**Transformation Ratio**

	<b>Panel Type</b>		<b>1250A Bus Bar</b>	<b>2000A Bus Bar</b>
a)	Incomer Panels	-	800-400/5-5-1-1 -1 A	1200/5-5-1-1-1 A
b)	Out going Panel for Feeder	-	400-200/5-5 A	400-200/5-5 A
c)	Out going Panel for Aux Trfr	-	200-100/5-5A	200-100/5-5A

**Rating**

		<b>Core -1</b>	<b>Core -2</b>	<b>Core -3 &amp;4</b>	<b>Core-5</b>
1	Purpose	Backup	Metering	Differential	REF
2	Rated output (max)*	15 VA	15 VA	-	
3	Class of Accuracy	5 P 10	0.5 S	PS	PS
4	Accuracy limit factor	10	-	-	
5	Kvp (Min V)			300V at Lower ratio	300 V at Lower ratio
6	Maximum Excitation current at V <sub>k</sub> /2			60-80mA	60-80mA
7	Secondary Resistance at 75°C.	Less than 2.5 Ohms (Less than 3.5 Ohm for 1200/1)			

\*Burdern calculation to be provided as per the metering and relay requirement during detailed engineering. Back up protection CT used shall have good knee point more or less equal to PS



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Class . Instead of 5P10 Class PS Class core may be used to meet above requirement.

NEUTRAL CTs	1250A Bus Bar	2000A Bus Bar
Type	Outdoor type	Outdoor type
Ratio	800-400/ 1 A	1200/1A
Class of Accuracy	PS	PS
Purpose	REF	REF
Minimum Knee Point Voltage	300 V at Lower ratio	300 V at Lower ratio
Maximum excitation current at $V_k/2$	60 – 80 mA	60 – 80 mA
Secondary Resistance at 75°C.	Less than 2.5 Ohms	Less than 3.5 Ohms

- c) **Potential Transformers:-** Potential Transformer as per the specifications shall be provided on the cable side on each incomer. **Mounting of PTs on CB truck is not acceptable**, Fuses shall be provided in primary and secondary windings. The PT Primary and secondary neutrals are to be earthed separately and brought out through isolating links for testing purpose. The primary neutral earth shall get firm earth connection before phase connections are made, when pushed into service. The PT secondary circuit from the PT shall be routed through the auxiliary contact of the incomer to avoid any chance of the back feeding when the incomer is switched off. The PT may be of resin cast type with insulation class of E or better. The wiring shall be as per standard procedures with proper ferruling and colored wires. There shall be permanent engraved marking for primary and secondary terminals polarity, core identification etc. Ratio (11kV/ $\sqrt{3}$  / 110 V/ $\sqrt{3}$  Volts):-

Parameters	Requirements
No. of Cores & Ratio	1 Core, 11kV/ $\sqrt{3}$ / 110V/ $\sqrt{3}$ Volts
Purpose	Metering
Class	0.5
Type	Shall be cast resin type with insulation class of E or better



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Rated Burden (Max)*	100VA
Mounting	a) It shall be mounted on a withdrawable carriage. <b>Mounting of PT on the breaker truck is not acceptable.</b> In case it is mounted on the panel rear top, access to the PT and the reinforcement in the panel stand, should be provided for manual inspection/ testing. Safety shutters shall be provided and closed on live side while PT is in draw out condition. b) Draw out type Potential Transformer is specified for easy isolation during testing and maintenance. If the bidder can provide crank operated switch for isolating the PT primary side, then fixed type can be accepted.
Neutral	The HV Neutral connection to earth shall be easily accessible for disconnection during HV test

\*Burden calculation to be provided as per the metering and relay requirement during detailed engineering.

The incomer panel energy meters and kV meter shall be supplied from the respective PT. The outgoing panels shall be provided with the respective incomer PT if the bus coupler is open. The PT of live incomer may be selected if only one-incomer and bus coupler is in service. The PT of the respective incomer may be taken as selected PT for that side if both the incomers and bus coupler are in service (Left side from No.1 PT and right side from No.2 PT). In the event of failure of PT supply from any one of the PTs, all outgoing panels shall be supplied with the PT supply of the healthy PT. Foolproof arrangements and double check provisions are to be made for PT selection in order to avoid voltage mixing and back feeding.

- d) **BUS BARS:-** Panels shall be provided with one set of 3 Phase and 1250 /2000A (as the case may be) heat shrunk HT Sleeved insulated Main Electrolytic Grade Copper bus bars and shall be connected in a separate moisture and vermin proof sheet metal chamber. The contact resistance of all bus bar connections shall not exceed  $20\mu\Omega$ . The bus bars connections & insulator supports shall be mechanically strong to withstand the mechanical and electrical stresses and high temperatures due to severe short circuit faults.



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Bus bars shall be of constant cross sectional area throughout their length with connection as short and straight as possible. Bus Bar shall be sleeved and insulated for full rated voltage. Sleeve shall be heat shrinkable . **PVC Sleeve in Bus Bar is not acceptable.** Suitable pressure relief facilities shall be provided without endangering operating personnel. Access to bus bar and the connections directly connected there shall be achieved by the removal of the bolted covers. Such covers shall be clearly marked “**BUS BARS- 11 KV LIVE**”.

Bus bars shall be supported on insulators at short intervals keeping adequate clearance as per Statutory rules between bus bars and earth. However the minimum clearance between phases and phase to earth should be as per Type Tested design. Provision shall be made for future extension of bus bar & switch board. End connections suitable for extension of Panels shall also be supplied for both the end panels. Efforts shall be taken to avoid any sharp edges.

**Short time Current rating of Bus Bar : 25kA for 3 Seconds.**

**Bus bar size 2 runs of 60mm x 10mm (Minimum) for 1250A busbar and 2 runs of 100mm x10mm or 3 runs of 75mm x 10mm for 2000A busbar – insulated with heat shrinkable HT sleeve or better per phase.**

**Dropper size shall be such that current density is not more than 1.2A/sq.mm.**

Bus bars shall be suitably holed and silvered at Cable connection points.

**For bus bar joints, dropper connections and CT connections, there shall be minimum four bolts per joint without affecting specified current density in the joint face.**

The bus bar supports and other insulating barriers shall be of materials, suitable for service under tropical climatic conditions.

Provision shall be made for expansion and contraction of bus bars and connectors with variation of temperature.

**7) CONSTRUCTIONAL FEATURES**

The panels shall be of folded construction duly reinforced and shall be **free standing** and structurally independent taking into account the weight of the mounted equipments. All the panels shall have machine punched holes in their sides for the purpose of bolting on to the adjoining panels to form continuous board. Necessary foundation bolts required for site erection shall also be supplied. The cut outs for bus ducts shall be provided with blanking plates on the side of the end panels on both ends. All other holes provided at the end panels for facilitating extension shall be suitably blanked off. The design of panels shall be such that



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no permanent or harmful distortion occurs in them when being lifted by eye bolt or when moved into position by roller or transportation.

**It is responsibility of the supplier to ensure that the equipment specified and such unspecified complementary equipment required for completeness of the protections/control scheme shall be accommodated in the panels.** As the incomer panel contains 5 core CT's as opposed to 2 core CT's in O/g feeder panels, adequate width shall be given in the incomer panel to avoid congestion inside the incomer panel and also to avoid poor accessibility to CT terminals. The panels shall be completely enclosed to ensure dust, moisture and vermin proof atmosphere. Design material selection and workman ship shall be such as to result in neat appearance, inside and outside with all welds, rivets smoothly finished.

Each stationary unit shall be provided with an instrument and relay panel of sheet steel construction, with hinged front door and a minimum of 2 Nos. locking handles. The instruments, meters and relays shall be of the flush mounting type and shall be mounted on the front of the panel.

1	Enclosure Type	Free standing, indoor, Fully compartmentalized, moisture, dust proof and Vermin-proof
2	Enclosure degree of protection	IP 4X for High Voltage compartment, IP 5X for low voltage compartment
3	Enclosure Material	CRCA steel
4	Load bearing members	Minimum 2.5 mm thick
5	Doors and covers	Minimum 2.0 mm thick
6	Gland Plate (detachable type)	3.0 mm MS detachable type
7	Extensibility	On either side
8	Separate compartment for	Bus bar, circuit breaker, HV incoming cable, HV outgoing cable, PT, LV instruments & relays.
9	Inspection window	For viewing indicators located in CB and to check switching device truck.( Transparent materials used shall be strong enough as per type tested design to withstand Internal Arc Test)
10	Breaker compartment door	Separate with lockable handle (design with breaker trolley as the front cover is not acceptable)



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11	Breaker to bus bar compartment	Through seal off bushings
12	Breaker to cable compartment	Through seal off bushings
13	Pressure relief devices	To be provided for each HV Compartment
14	Bus support insulator	Non hygroscopic, track-resistant, high strength, epoxy insulators. Self supported Bus Bar can also be accepted
15	Fixing arrangement of doors	Concealed hinged Bolted with SS bolts and Neoprene gaskets (Sufficient number of hinges are to be provided )
16	Required HV cable termination height in the cable compartment	Shall be specified by supplier as per relevant standards
17	Panel Base Frame	Steel base frame of standard sections.
18	Handle	Removable bolted covers for cable chamber and busbar chamber shall be provided with "C" type handles
19	Internal Arc Routing Baffles	To be provided for HV Compartments
20	Closed pressure relief duct	To be provided
21	Racking in/ Out of CB Truck with front door closed.	To be provided
22	Cable Earthing Truck	To be provided

**8) PAINTING**

- a) Panel painting shall be done by the modern process of painting. All surface of the steel panel and frame work shall be sand blasted and suitably treated to remove rust, scale, foreign adhering matter or grease.
- b) A suitable rust resisting primer shall be applied on the interior and exterior surface of steel, which shall be followed by application of an undercoat suitable to serve as base and binder for the finishing coat.





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c) Details of Painting

Surface treatment	by seven (or eight) tank process
Phosphating	All sheet steel work shall be zinc phosphated in accordance with IS-6005 "Code of practice for phosphating iron and steel"
Paint type	Powder coated. Pure polyester base grade A structure finish
External Paint shade and finish	Light grey shade 631 as per IS 5 with structure finish
Internal Paint shade and finish	White with semi glossy finish.
Base Frame Paint shade	Black
Paint thickness	Minimum 80 micron

**9) NAME PLATE AND IDENTIFICATION MARKINGS**

- a) All instruments, relays and such other similar electrical devices mounted on the panel shall be provided with individual name plates with equipment designation bearing the manufacturer's name, serial identifying number and the Electrical rating data engraved.
- b) Similar identification plates shall be fixed on the exterior of the panel in appropriate places to indicate function of control switches, push button, control switch, DC fail test, accept reset etc. Suitable identification marks shall be provided for individual casing part of the relays and other equipment. Plates should be screwed and riveted to the Panel.
- c) Large and bold name plates shall be provided on the top of each panel on front as well as rear side for indicating circuits/ feeders designations. 50mm wide black anodized aluminium plate bearing suitable circuit description etched in 30 mm size letters shall be provided for each panel. These plates shall be removable type.
- d) Each unit of panel shall be provided with a Name Plate located at the bottom on the front door and shall contain the following details :
- i) Manufacturer's name, Model No.
  - ii) Purchase Order No. and date
  - iii) Serial No./ Month & Year of Manufacture



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**TECHNICAL SPECIFICATION**

**11KV INDOOR VCB PANEL**

Doc. #: **SCM-SPEC/XT/11kV Indoor VCB Panel**

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- iv) Drawing ref. no. pertaining to the panel.(GA & Schematic)
- v) Rated Voltage
- vi) Rated Current
- vii) CT Ratio
- viii) Control Voltage.
- ix) Guarantee Period.
- e) Nameplates shall be made of non-rusting metal. Nameplates shall be black with **engraved/ punched** lettering. The nameplates inscription and size of nameplate and letters shall be submitted to the purchaser for approval.
- f) Each Indicating instrument and meter shall be prominently marked with the quantity measured (ie. kV, A).

1	Lettering	Engraved, with white letters on black background
2	Name plate for feeder description & number	On front and rear side of each panel giving feeder description. On the rear side the name plate shall be fixed on the frame.
3	Identification plates/labels at each cubicle and each instrument	Approved design (not stickers)
4	Manufacturer name plate	On Bottom of Front Door
5	Danger Board	Cable entry Box and wherever is required

Each CB truck shall be provided with a Nameplate/ rating plate indicating the Make, Type, Model Number, Serial Number, Purchase Order Number, Date of manufacture, Rating as per standards like Voltage, Ampere, Breaking Capacity, STC, Internal Arc Class designation, Operating Sequence, Contact rating, Control voltage, Spring charging voltage, etc. The Name/ Rating plate shall be got approved by KSEBL during detailed engineering.

**10) LABELLING**

- a) All front mounted as well as internally mounted items including MCBs shall be provided with individual identification labels. Labels shall be mounted directly below the respective equipment and shall clearly indicate the equipment designation. Labelling shall be on aluminium anodised plates ( 50mmX15mm) of 1 mm thickness,



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letters are to be properly engraved. Letter size 75mm.

- b) All front mounted equipment shall also be provided at the rear with individual name identification labels engraved with the tag numbers corresponding to the one shown in the panel internal wiring to facilitate easy tracing of the wiring. The nameplates shall be mounted directly below the respective equipment and shall not be hidden by the equipment wiring.

### 11) BUS CHAMBER

Bus bars shall be contained in a separate air insulated compartment with the general casing of the switchgear. The bus bar chamber shall be air insulated. Interconnecting Bus Bar Links are to be provided. The bus bar chamber shall be provided with inspection covers with gaskets & bus bar shutters.

### 12) CIRCUIT BREAKERS

The circuit breaker shall be of vacuum type and shall have a minimum three phase short circuit rupturing rating of 500 MVA. Doors shall be provided for all circuit breakers. Visual indication of spring charged/discharged condition and ON/OFF positions shall be provided.

**Vacuum interrupters of the circuit breakers shall be completely encapsulated in epoxy housing. The Circuit Breaker shall be suitable for E2 M2 & C2 class duty.** The offered circuit breaker should have valid type test certificate to support the afore-mentioned duty class.

Means shall be provided for isolating circuit breaker unit. There shall be easy access to contacts for inspection and repairs. The breaker shall be mounted on horizontal withdrawable truck with horizontal or vertical isolation. **Circuit Breaker truck shall have 'Rack in/out' facility without opening of the doors. There shall be three positions viz; "Service", "Test" and "Isolated".** In Service position the Main & Auxiliary control contacts shall remain connected. In Test Position the Main contact shall remain disconnected, Shutters closed, Auxiliary Control contacts shall remain connected and the Circuit Breaker shall remain in the apparatus enclosure with the compartment door closed. **Locking of Circuit Breaker shall be possible in Service, Test and Isolated Position.** A position indicator (both mechanical (on the CB) and Electrical (through LED lamps in the LT compartment door) shall be provided for indicating the Service, Test, Isolated position, etc. Provision for remote indication of Service, Test and Isolated position of Circuit Breaker shall be provided by wiring the spare contacts to terminal block. In the isolated position the auxiliary contacts will be



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disconnected and CB shall remain in the apparatus enclosure with the compartment door closed.

**Suitable guiding arrangements shall be provided for the racking handle of Circuit Breaker truck, to ensure easy alignment of entry hole in door with slot/socket in Circuit Breaker truck. Racking handle entry hole shall be positioned such that sufficient clearance from floor level is available during operation.**

### 13) **CIRCUIT BREAKER OPERATING MECHANISM**

The circuit breaker shall be arranged for motor charged spring stored energy operation type. Manual charging of the operating mechanism shall be provided in addition. Suitable electrical interlocking mechanism for preventing motor operation during manual spring charging shall be provided. The motor shall be suitable for **230V AC** operation. The tripping mechanism shall have both mechanical and electrical releases. Mechanical release shall be operated by means of push buttons and electrical releases by means of switches and protective relays. The operating mechanism shall be trip free as defined in clause 2-38 of IS.2516 Part –I 1963. The trip coil and closing shall be suitable for connection to a 110 Volt DC supply. Hand trip device shall also be provided. The tripping circuit shall allow operation with 70 to 110% of rated DC auxiliary voltage and closing circuit shall allow 85 to 110% of rated DC auxiliary voltage. The spring charging motor shall operate from 90% to 110% of rated voltage.

**Provision for switching off the breaker mechanically shall be available in the front side of the panel without opening the door.**

The circuit breaker operating mechanism shall be provided with a mechanical status indicating device to show whether the breaker is **Open or Close** .This indication shall be visible through the front transparent window of the CB.

Continuous glowing lamp indication (LED) shall be provided for indicating Trip healthy, DC healthy and Breaker ON/OFF with appropriate labels. Separate relay shall be provided for continuous trip circuit monitoring. Trip healthy indication (pre-close & post close) shall cover all contacts in between the trip coil and the relay contacts.

**The insulators for the circuit breaker stationary contacts and supports shall be track-resistant, high strength epoxy insulators or any other approved material which is non-hygroscopic and unaffected by moisture. The circuit breaker shall be provided with necessary heavy duty auxiliary switches for indication, protection, control and other services required. The connections of the control wiring from the stationery portion of the**



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switchgear to its movable portion shall be arranged through secondary contacts of robust design.

**14) HV CABLE CONNECTION**

The power cable entry/exit point shall be provided with a removable gland plate and is located at the base of the cable compartments. Suitable cable entry provision shall be made on removable gland plates for **6 runs of 1 core 11kV 500 sq.mm for incomer panels and 1run 3 core 11kV 300sq.mm for Outgoing panels ( Aluminium XLPE Cables)**. Brass Glands suitable for above shall be provided. Blanking plates /knockout plates shall be provided for cable entry holes.

Phase identification markings shall be provided with respective colours at cable termination and rear side of panel.

Proper support shall be provided to avoid possible mechanical stresses on cable termination.

Bus bars shall be suitably holed and silvered at cable connection points.

Entry of the external LT Cables shall be in the rear side of bus riser panel and from there to incoming panels.

**15) GUARDING SHUTTERS**

The stationary isolating contacts connected to the bus bars, the voltage transformers and the incoming and outgoing cables of the switchgear shall be provided with cover (painted & marked "11 KV LIVE ") to prevent access when the circuit breaker or voltage transformer is withdrawn. The covers shall be opened or closed automatically by the positive movement of the circuit breaker or the voltage transformer.

**16) INTERLOCKING GEAR**

The switchgear shall be provided with efficient interlocking gear to prevent.

- 1) The breaker being removed while in service.
- 2) The breaker being inserted in the 'ON' Position. It should not be possible to Rack-in the Circuit Breaker from the Test to the Service Position unless and until the Circuit Breaker is in Switched Off condition, Circuit Breaker Chamber Door closed and Control plug is connected.
- 3) Breaker withdrawal before switching off the vacuum bottle and unlocking the interlocking lever.

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- 4) The closing of the circuit breaker when its terminals are not properly engaged with the stationary contacts.
- 5) Access to live parts of the switchgear when the circuit breaker is withdrawn.
- 6) The circuit breaker being put in service without its control / auxiliary wiring and without LV control plug connected.
- 7) Removal of Control wiring / plug shall not be possible when the circuit breaker is in Service Position.

<b>A</b>	<b>Circuit breaker - Requirements</b>	
1	Mounting	On with-drawable truck or carriage, with locking facility in service position and test position.
2	Interrupting medium	Vacuum
3	Breaker operation	Three separate identical single pole units operated through the common shaft.
4	Operating mechanism	Re-strike free, trip free, with electrical anti-pumping feature
		One O-C-O operation possible after failure of power supply to the spring charging motor.
		Motor wound, spring charged, stored energy type with manual charging facility
5	ON/OFF/Emergency trip push button	i) Manual / mechanical ii) RED coloured Emergency Off push button to be provided with a Red colored protective flap. iii) Mechanical ON/OFF shall have padlocking facility.
6	Mechanical ON-OFF indication	On breaker trolley front inscribing "OPEN" and "CLOSE" on Green and Red Back ground respectively and electrical indication (LED) on the LT panel door.
7	Operation counter	On breaker trolley front
8	Mechanism charge/discharge indicator	On breaker trolley front and "Spring Charged" electrical indication (LED) on the LT panel door.



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9	Breaker positions	Service, test and isolated mechanical position indicator on the breaker trolley front and electrical indication (LED) on the LT panel door.
10	Inter changeability	Possible, only with breaker of same rating
11	Breaker control	On panel front only
12	Handle	Breaker shall be provided with handles for easy handling, rack in-out operation and manual spring charging as applicable.
13	Operating Sequence	O-0.3 sec-CO-3 min-CO
<b>B Functional Requirements</b>		
1	Interlock and safety devices	
2	Breaker compartment door opening	Can't be opened unless breaker is OFF in Service Position and irrespective of Breaker Status in Test and Isolated positions.
3	Breaker compartment door closing	Should be possible even when breaker in isolated position.
4	Racking mechanism safety interlock	Mechanical type
5	Racking in or out of breaker inhibited	When the breaker is closed
6	Racking in the circuit breaker to Service Position inhibited	Unless the control plug is fully engaged, Circuit Breaker Open and Compartment door closed
7	Disconnection of control plug inhibited	As long as the breaker is in service position
8	Locking of Circuit Breaker movement	In Service, Test and Isolated position
<b>C Additional Requirement</b>		
1	Exposure to live parts	In case the breaker panel door is required to be opened during a contingency, the personnel should not be exposed to any live parts. Suitable shrouds / barriers / insulating sleeves should be provided as required.



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2	Breaker handling	In case the breaker is mounted on the carriage, which does not naturally roll out on the floor, a trolley for handling the breaker is to be provided. The trolley arrangement should ensure that the isolated breaker can be easily rolled on to the trolley with easiness and taken away. Two trolleys per switchboard for each breaker type shall be included in offer.
3	Operation of breaker	Electrical and Manual in either Service or Test position and Manual in Isolated Position
4	Closing from local	Only when local/remote selector switch is in local position
5	Closing from remote	Only when local/remote selector switch is in remote position
6	Manual Tripping from local	Only when local/remote selector switch is in local position except for emergency tripping
7	Protection Tripping	Irrespective of selector switch position
8	Emergency Tripping	Should be possible Irrespective of Local/ Remote selector switch position
9	Testing of breaker	In test position keeping control plug connected
<b>D Safety shutters</b>		
1	Automatic safety shutter for fixed contacts	To fully cover contacts when breaker is withdrawn to test. Independent operating mechanism for bus bar & cable side shutters, separately pad lockable in closed position
2	Label for identification	For bus side and cable side shutters
3	Warning label on shutters of incoming and other connections	Clearly visible label "isolate elsewhere before opening shutter and earthing" be provided





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Shutters shall be painted & marked "11kV LIVE".  
Shutters shall be colored as Red for bus side and Yellow for cable side.  
**Guarding shutters with locking facility in Bus Coupler Panels shall be properly labeled for respective sections. Phase identification shall be clearly shown.**

<b>E</b>	<b>Breaker electrical operation features</b>	
1	Trip circuit supervision	To be given for breaker close and open condition
2	Trip circuit supervision relay contact	For indication, alarm & to inhibit closing of breaker on failure of trip circuit healthiness.
3	Emergency Trip Push button contact	Wired to inhibit closing of breaker. Mushroom Pushbutton with manual release and protection flap shall be provided.
4	Master trip relay contact	Wired to inhibit closing of breaker unless reset.
5	DC Control supply bus in all panels	Fed by DC Incoming source
6	PT supply bus in all panels	Fed normally from respective incomer PT. In the event of multiple incomers, a PT selection scheme shall be provided to ensure supply to the meters in the corresponding panels in a section in the event of outage of the Incomer in that section. For switchboards with only one Incomer but with provision for additional feeders, necessary provision shall be made in the control wiring schematic for incorporating the PT selection scheme at a later stage on addition of the proposed future Incomer.
7	Trip circuit faulty	Wired to inhibit closing of breaker



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**17) PANEL EARTHING**

VCB truck shall maintain positive earthing when inserted in the VCB Cubicle from Isolated to Service position.

All panels shall be equipped with an earth fixed along the inside base of panels. The materials and the sizes of the bus bar shall be at least **50x6 mm electrolytic grade tinned copper flat** unless specified otherwise. When several panels are mounted adjoining each other, the earth bus shall be continuous and necessary connectors and clamps for this purpose shall be included in the scope of supply. Provision shall be made for extending the earth bus bar to future adjoining panels on either side. Provision shall be made on the earth bus bar of the end panels for connecting to purchaser's earthing grid. Necessary terminal clamps and connectors for this purpose shall be included in the scope of supply. All metallic case of relays, instruments and other panel mounted equipments shall be connected to earth bus by independent copper wire of size not less than **6 sq.mm**. The colour of earthing wire shall be green. Earthing wire shall be connected on terminals with suitable clamp connections and soldering shall not be permitted. VT and CT neutral or common lead shall be earthed at one place at the terminal blocks where they enter the panel. Such earthing shall be made through links so that earthing may be removed from one group without disturbing continuity of earthing system for other groups.

Equipment Earthing		
1	Material of earthing bus	Electrolytic Grade Tinned Copper
2	Earth bus joints	All bolted joints in the bus will be effected by connection of two bolts.
3	Rating	Sized for rated short circuit current for 3 seconds.
4	Enclosure and non-current carrying part of the switchboard/ components	Effectively bonded to the earth bus
5	Hinged doors	Earthed through flexible copper braid
6	Circuit breaker frame /	Earthed before the main circuit breaker contacts/control

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**18) EARTHING DEVICES**

Each panel set shall be provided with one earthing truck for connecting incoming/ outgoing cable to earth during maintenance. Warning boards shall be provided regarding operational safety.

**19) PANEL WIRING**

All panel instrument wiring shall be neatly fixed in single layer, on the sides of the cubicles and shall be carried out with tinned copper wire, PVC insulated and of cross section of not less than 1.5 sq.mm. The CT and PT wires shall have a minimum cross section of 4sq.mm and properly coloured (red, yellow, blue & black) wires shall be used for each phase. The small wiring shall be terminated in suitable terminal strips easily accessible for maintenance purposes. Round ring type ferrules are to be used in all cases. 'U' type or pin type shall not be used.

All wires on the panels and multicore cables shall have PVC ferrules of the interlocking type. The ferrules shall be white or yellow in colour but all tripping circuits shall be provided with red ferrules marked 'Trip'. The marking on the ferrules shall be black in colour. The characters on the interlocking type ferrules shall be deeply engraved ensuring maximum permanency.

The panel wiring shall be **1100V** grade with copper conductor and shall conform to ISS.694. Both ends of wire are to be provided with colour bands with the same number as shown to facilitate easy maintenance and inspection.

<b>Internal Wiring</b>		
1	Internal wiring	1100V grade PVC insulated stranded flexible copper wire. <b>(FRLS)</b>
2	Size	4 sq. mm for CT circuit, 4 sq mm for PT and 1.5 sq. mm for control circuit, 6 sq mm for earthing (minimum)
3	Colour code	
i	PT	R ph – Red, Y Ph – Yellow ,B Ph – Blue ,Neutral – Black
ii	CT	R ph – Red, Y Ph – Yellow, B Ph – Blue ,Neutral – Black
iii	Others	DC – Grey, AC-Black, Earth – Green with Yellow stripe
4	Ferrules	At both ends of wire.
5	Ferrule type	Interlocked type (one additional red colour ferrule for all wires in trip circuit)



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6	Lugs	Tinned copper, pre-insulated, round type.
7	Spare contacts of relays, timers etc	Wired up to the terminal blocks
8	Wiring enclosure	Plastic channels, inter panel wiring through PVC sleeves or suitable grommets.
9	Inter panel wiring	Wiring with ferrule to be terminated in the adjacent shipping section will be supplied with one end terminated and the other end bunched and coiled.
10	CT Wiring	All CT core taps are to be wired up to TB for ratio selection. Starring to be done at TB only. The control cables for external CT wiring shall be routed through metallic ducts with safe clearance from the power cables in order to avoid flash over.

**20) TERMINAL BLOCKS**

Terminal blocks shall be 1100V grade and have 10 amps continuous rating, one piece moulded, complete with insulated barriers, stud type terminal, washers, nuts, lock nuts and identification strips. Terminal block design shall include white fibre marking strip with clear plastic, slip-on/clip-on terminal covers.

Marking on the terminal strips shall correspond to wire number in the wiring diagrams. Not more than 2 wires shall be connected to any terminal. Suitable supports shall be provided for the incoming cables. The terminal blocks shall be arranged to provide maximum accessibility to all conductor terminations. The terminal blocks shall be fully enclosed with easily removable covers and made of moulded non-inflammable plastic material with bases and barriers moulded integrally.

Terminal blocks for current transformer and voltage transformer secondary leads shall be provided with test links and isolating facilities. Also current transformer secondary leads shall be provided with short circuiting and earthing facilities.

At least 20% spare terminals for all circuits shall be provided on each panel and these spare terminals shall be uniformly distributed on all terminal blocks.

1	Terminal Blocks (TB)	1100V grade, 10 amps min. rating,
2	Terminal for CT secondary leads	With provision for shorting with screw driver operated sliding link.



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3	Spare terminals	20% in each TB row
4	TB shrouds & separators	Moulded non-inflammable plastic material
5	Clearance between 2 sets of TB	100 mm min.
6	Clearance with cable gland plate	250 mm min
7	Clearance between AC / DC set of TB	100 mm min
8	Test Terminal blocks	Screw driver operated stud type

**21) INDICATING INSTRUMENTS**

21.1. Indicating instruments shall meet following requirements:

<b>Meters</b>	
Mounting	Flush Mounted
<b>Ammeter</b>	Taut band, moving coil type, 240° Scale
Size	96 X 96 mm
Accuracy class	1.0
<b>Voltmeter</b>	Digital
Size	48 X 96 mm
Accuracy class (min)	1
Range	0-12kV (up to a minimum of 2 decimal places)
Display	20mm super bright LED display 3 1/2 digit
Voltmeter has to display R-Y, Y-B, B-R and R-N, Y-N, B-N voltages in incomers (for incomer VT supply) and bus coupler (for selected VT supply) panels.	

**21.2 TOD Energy meter**

Type	:	ToD type Bi-directional 3phase, 4 wire, 11/√3 kV/110V3V, 5A
Frequency	:	50 Hz +/- 5%
P.F.	:	0.5 PF Lag - Unity - 0.5 P.F Lead
Burden	:	0.2VA max. per Volts/Amp. Input 3VA max.
Accuracy class	:	0.5S



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Display	:	Multifunctional meter with LCD display for parameters like kW, kWh, kVAh, kVARh, MD, I, V, pf & Hz shall be available by scrolling. There can be 1, 2, or 3 mode of display, which facilitate more parameters. More accurate reading of power etc up to 6 decimal place shall be provided in the mode 3. Retains the last ordered reading even under power failure. Default setting for any parameter say kWh shall be given. Shall display import & export. Shall have data retrieval & logging facility and <b>Load Survey Feature</b> . Necessary software for feeding settings, commissioning, testing etc and required inter facing cables shall be supplied with each set of Panel
Data communication	:	RS 485 port with MODBUS RTU protocol shall be provided. Data communication port with DLMS protocol shall be provided / enabled.

Energy meter RS 485 MODBUS connection is to be wired up to terminal block for Automated Meter Reading purpose.

## 22) TEST TERMINAL BLOCK

For Energy meters Switch board type, back connected semi flush mounting type test blocks with contacts suitably rated shall be provided with links or other device to enable of a series device into circuit without causing open circuit in the CT secondary or to enable short circuiting of the CT Secondary.

- Test block covers shall be removable from the panels and shall be provided with suitable sealing arrangement to prevent unauthorised access to the test studs.
- A 3 phase 4 wire Link type TTB with back connection for Energy meter and shall be placed near to the meter.
- All terminals, shorting links and screws shall be of brass and nickel plated to prevent corrosion.
- Meters shall be connected after TTB for testing their accuracies and also for Energy meter calibration.
- TTB's shall be more rugged in construction.



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**23) INDICATING LAMPS**

Indicating lamps (with bunched LEDs) shall be of miniature switchboard type, **Metallic**, suitable for panel mounting with rear terminal connections. The lamps should be mounted in such a way that it can be replaced easily. Lamps shall be provided with suitable protection preferably built on the lamp assembly to avoid short-circuiting of control supply in the event of short-circuiting of lamp. These lamps shall be of screwed on type, unbreakable and moulded from heat resisting material. They shall be translucent to diffuse light. Integral inscription plates engraved with their function shall be provided. Unless otherwise stated, the lamp covers shall be coloured as follows:

1	Mounting	Flush mounted
2	Type	Metallic
3	Lamps	High intensity, clustered LED type
4	Breaker ON	Red
5	Breaker Off	Green
6	Spring Charged	Blue
7	DC Control supply fail	Yellow
8	Auto trip	Amber
9	Service position	Blue
10	Test Position	White
11	Heater circuit healthy	Yellow
12	Trip circuit healthy	White
13	PT supply as applicable	R, Y, B
14	Capacitive Voltage indicator for monitoring whether the Cable is Live or Dead	By LED indication for R,Y,B Phase through bushing mounted Capacitive type feedback.

**24) PUSH BUTTONS**

- a) Push buttons of suitable colours shall be housed in metallic case, momentary contact type, semi flush mounted with rear terminal connection.
- b) These shall be suitably shrouded to prevent inadvertent operation.
- c) Integral inscription plates engraved with their function shall be provided.
- d) All push buttons shall have two normally closed and two normally open contacts comprising rivets of pure silver.

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- e) **The contacts shall be able to make and carry 5A and break 1A Inductive load at 250V DC.**

1	Mounting, Type	Flush mounted, momentary contact type
2	Casing	Metallic
3	Emergency trip push	Red color with stay put (shrouded)
4	Accept push buttons	Black color – trip alarm / DC fail alarm
5	Reset push buttons	Yellow color – trip alarm / DC fail alarm
6	Test push buttons	Blue color
7	Rating	5 A

**25) CONTROL AND SELECTOR SWITCH**

- a) They shall be of rotary operated type preferably with silver to silver contacts adequate making, carrying and breaking current rating.
- b) They shall be provided with easily removable protective terminal covers and escutcheon plates clearly marked to show operating position and shall be suitable for flush mounting with only switch front plate and operating handle projecting out.
- c) The connection shall be from the back.
- d) The contact assembly at the switch shall be enclosed in dust proof removable covers.
- e) The control springs shall be strong and robust enough to prevent inadvertent operation due to light touch.

1	Switches mounting	Flush mounted on LV compartment door, with shrouded terminals
2	Circuit Breaker Control Switch	Pistol grip lockable robust handle spring return to normal position, Trip- Neutral- Close , 16A ( Handle or base of breaker Control switch shall have Red Colour )
3	Rotary ON/Off switches	For heater & spring charging circuits
4	Selector Switches	Stay put type
5	Local Remote Selector Switch	Two Position, with three set of contacts. Suitable to give status input for SCADA controls





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**26) RELAYS**

**Approved make of Relays: ABB/Alstom/GE/ SEL/ Schneider Micom/Siemens(except 7SR series)**

- 1) Relays shall conform to the requirements of IS 3231(Electrical Relays for power system protection) or IS 8686 or IEC 60255 or other applicable approved standards, as the case may be.
- 2) Relays should be suitable for flush mounting on the front with connections from the rear.
- 3) Relays shall be rectangular in shape and shall be dust tight.
- 4) The auxiliary relays and timers shall be modular type.
- 5) All AC relays shall be suitable for operation at 50 Hz. AC Voltage operated relays shall be suitable for 110V PT secondaries and current operated relays for 1A/5A CT secondaries. DC auxiliary relays and timers shall be designed for DC voltage specified and shall operate satisfactorily between 70% and 110% of rated voltage. Voltage operated relays shall have adequate thermal capacity for continuous operations.
- 6) The protective relays shall be suitable for efficient and reliable operation of the protection scheme described in the description in the specification.
- 7) Necessary auxiliary relays and timers required for interlocking schemes for multiplying of contacts, suiting contact duties of protective relays, and monitoring of control supplies and circuits lock out relays monitoring circuits etc. and also required for the complete protection schemes described in the specification shall be provided.
- 8) All protective relays shall be provided with at least two pairs of potential free isolated output contacts. Auxiliary relays and timers shall have pairs of contact as required to complete the scheme.
- 9) Contacts shall be silver faced with spring action. Relay cases shall have adequate number of terminals for making potential free external connections to the relay coils and contacts. Paralleling of contacts, if any shall be done at the terminals on the casing of the relay.
- 10) All protective relays, auxiliary relays and timers except the lockout relays and interlocking relays specified should be provided with self-reset type contacts. All protective relays, trip relays and timers shall be provided with external manual reset positive action operation indicators provided with inscription subject to purchaser's approval.



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- 11) No control relay that trip the power circuit breaker when the relay is de-energised shall be employed in the circuits.
- 12) Provision for easy isolation of trip circuits of each relay for purpose of testing and maintenance shall be incorporated. Suitable device for indication of operation of each protection shall be provided along with resetting device on front of the panel.
- 13) Auxiliary seal-in-units provided on the protective relays shall preferably be of shunt reinforcement type. All necessary provision for easy testing of relays shall be provided. If series relays are used the following shall be strictly ensured.
  - a) The operating time of the series seal in unit shall be sufficiently shorter than that of the trip coil or trip relay in series with which it operates to ensure definite operation of the flag indicator of relay.
  - b) Seal in unit shall obtain adequate current for operation when one or more relays operate simultaneously.
  - c) Impedance of the seal unit shall be small enough to permit satisfactory operation of the trip coils or trip relays when the D.C. supply voltage is minimum.
- 14) The printed circuit cards shall be of fiberglass type and the contact shall be gold plated. All connections with the connector pegs shall be through wire wrapping. All solder joints on the printed circuits boards shall be encapsulated or covered with lacquer for protection from environment.
- 15) The components shall be loaded by less than half of their rated values. The resistors shall be of carbon composition or metal oxide type and capacitors shall be plastic film or tantalum type. Stringent measure including shielding of long internal wiring should be taken to make relays immune to voltage spikes. The relays must withstand 5KV; 1x150 micro second 0.5 joule source energy impulses test or 1.5 MHz damped oscillations with initial value (zero to peak) of 2.5KV decay to half the initial value of 6 micro seconds with internal sources impedance of 150 ohms as per IEC Standard.
- 16) All relays shall be designed for operating under an ambient temperature of 50<sup>0</sup> C and 100% relative humidity.
- 17) All devices required for correct operation of each relay shall be provided by the supplier without any extra cost.
- 18) All numerical relays shall be provided with 'Relay Failure Annunciation contact'.
- 19) At least one output relay from all numerical relays shall be configured for any trip and shall be wired up to TB for testing purpose exclusively.



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- 20) The supplier shall ensure that the terminals of the contacts of the relays are readily brought out for connections as required in the final approved scheme. The type of the relay case size offered shall not create any restrictions in the availability of the contact terminals for wiring connections.
- 21) Provision of DC cell for the protective relays as reliable stand by power supplies will not be acceptable.
- 22) The numerical shall be stable and suitably protected against transient/ induced over voltage.

**27) RELAY FEATURES**

**27.1. 3 Over Current & Earth Fault Relay with Sensitive Earthfault Element.**

Type	Numerical low burden having 3 Over current and 1 Earth fault relay with 3 voltage inputs, measurement functions, 6BI, 8BO,self supervision, IEC 61850 compliant, with Disturbance recorder and Event logger
Current Rating	5 Amp.
Curve	IDMT & DT
Indicators	LED with resetting facility. LEDs shall be provided for indicating faulted phase (R,Y,B) during Over current and Earth Fault (E/F) when corresponding protections are acted.(programmable)
Communication	(I) Front Communication Port USB/RJ45 for connecting Laptop (II) Rear Ethernet Port with IEC 61850
Binary Inputs/ Output (Minimum)	6/8 nos.
<b>Setting Range</b>	
TMS for IDMT O/C and E/F	0.05 to 1.5 in steps of 0.01
IDMT O/C Protection current setting	50% to 250% in steps of 5%
IDMT E/F Protection current setting	5% to 100% in steps of 0.5%



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High Set (50 & 50N) current setting	50% to 2500% in steps of 10%
<b>Sensitive E/F Element (Definite Time)</b>	
Current Setting	1% to 20%
Time Setting	0 to 20 sec in steps of 0.1 sec.
In case sensitive E/F Element is not available in 3O/C and 1 E/F relay, separate numerical Sensitive E/F relay with the above sensitivity and setting range is also acceptable. i.e. 5 separate elements required in total.	

**27.2. REF relay:**

Type	Numerical, High Impedance Instantaneous REF relay with seal-in type operation indicator with provision for reset and with suitable external stabilizing resistance (Variable 0-1000 Ohm) & Metrosil as applicable. Relay shall be tuned to the system frequency of 50Hz.
Current Rating	1 Amp.
Indicator	LED with resetting facility
Communication	Front Communication Port USB/RJ45 for connecting Laptop
Setting Range	0.1A to 0.4 A
Contacts	3 contacts for trip, alarm, inter trip respectively and shall have two tripping contacts and two alarm contacts minimum as spare
Wiring shall be done so that Disturbance Recorder in 3 Over Current & Earthfault Relay shall be triggered on operation of REF Relay.	

**27.3. TRIP CIRCUIT SUPERVISION RELAY:-** The trip circuit of CBs shall be supervised by separate electromechanical / Static / Numerical relays. This scheme shall continuously monitor the trip circuit before and after closing of the circuit breaker. This scheme shall detect

- (1) Failure of trip supply
- (2) Open circuit of trip circuits wiring

The relays shall have necessary contacts to be connected to either the alarm bell or to the annunciator available in the panel for visual and audible indication of the failure of trip circuit with sufficient spare contacts. One bunched type LED bulb indication shall be provided for "Trip Circuit Healthy" continuously. It shall not be possible to close during trip circuit faulty condition.



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**27.4 DC SUPPLY SUPERVISION RELAY:-** DC supply supervision scheme shall be provided in each panel using Electro-mechanical / Static type DC under voltage relay. In the event of failure of DC supply to annunciator, a bell operated by AC supply shall be energized. The alarm should be acknowledged through the alarm acknowledge push button of the panel.

**27.5. High Speed Tripping Relay**

Following shall be the main features of tripping relays :

- a) Be instantaneous (Operating time not to exceed 10 ms).
- b) Reset within 20 ms.
- c) Shall be high impedance type.
- d) Be DC operated - 110 V DC.
- e) Have adequate contacts to meet the requirement of scheme, and minimum 2 nos NO & NC contacts shall be provided as spare.
- f) Be provided with flag indicator.
- g) All contacts shall be reset with a single reset.
- h) All tripping relays shall be high speed high burden type.
- i) Normally closed contacts in series with the relay operating coil, shall be delayed for a period which will allow series flag relays to operate satisfactorily. All other tripping contacts should be instantaneous. i.e no intentional time delay.
- j) Work satisfactorily for an operating voltage range from 70% to 120% of rated voltage of the auxiliary voltage.
- k) High speed tripping relays shall prevent closing of the associated circuit breakers until reset. All tripping relays shall have inbuilt hand resettable flag indication.
- l) Be immune to capacitance discharge currents, which can result at the inception of an earth fault on DC wiring and immune to subsequent leakage current.

27.6. **Auxiliary Relays:** Shall be electro mechanical type to meet the scheme requirements.

27.7. LBB protection and under frequency trip shall be provided in the outgoing feeder panels.

**28) ANNUNCIATOR**

**28.1 Annunciator System**

Alarm annunciation system shall be provided for the Panels by means of visual and audible alarm in order to draw the attention of the operator to the abnormal operating conditions or the operations of some protective device. The annunciation shall be divided into the following two categories.

- i) Emergency annunciation.
- ii) Warning annunciation.



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The annunciation equipment shall be suitable for operation on DC supply as specified in the specification.

**28.1.1. Emergency Annunciation:-** This annunciation is used to draw the attention of the operator when the circuit breaker is tripped automatically. The audible annunciation shall be provided by means of "Hooter." The visual annunciation shall be flickering of common facia window provided on the respective panel on which the control of the tripped breaker is located. The tripped breaker shall be identified by the flickering of the corresponding position indication lamp.

**28.1.2. Warning Annunciation:-** The annunciation is used to draw the attention of the operator to the occurrence of an abnormal operating condition and then the tripping of the circuit breaker. The audible annunciations shall be provided by means of a bell and visual annunciation by flickering of the respective facia window. Certain numbers of alarms under this category have to be time delayed with the time delay adjustable between 2 to 10 seconds. The supplier shall provide arrangements for this purpose.

The audible alarm shall continue until the sound signal cancel push button is pressed. The sound signal cancel push button shall be common for cancellation of audible alarm hooter and bell.

**28.1.3.** The visual annunciation shall be provided by annunciation facia mounted on the top row of the panel. Necessary switching relays for the same shall be mounted inside the panel. It shall be provided with sufficient number of suitably sized rectangular facia with the size of the lettering not less than 5mm. Alarm inscriptions shall be engraved on each window in not more than three lines and shall be visible only when the facia light is on. The cover plates of the facia window shall be capable of easy removal to facilitate replacement of LEDs. The transparency of covers and wattage of the LEDs provided in the facia window shall be adequate to ensure clear visibility of the inscription from the location of the operator's table in the control room having high illumination intensity. Use bunch of LED connected lamp window.

28.1.4. The sequence of operation of the annunciator shall be as follows:

Alarm Condition	Fault Contact	Visual Annunciation	Audible Annunciation
i) Normal	Open	OFF	OFF
ii) Abnormal	Close	Flashing	ON
iii) Accept Push Button Pressed	Close	Steady ON	OFF
	Open	Steady ON	OFF



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iv) Reset Push Button Pressed	Close	ON	OFF
	Open	OFF	OFF
v) Lamp test Push button is pressed	Open	Steady ON	OFF

**28.2.** ELECTRONIC ANNUNCIATOR annunciation system described above shall also meet the following requirements.

- a) Suitable Multi-way Microprocessor based electronic Annunciator for the visual and audible alarm on the panel using bright LEDs shall be provided to indicate trip/alarm functions operated.
- b) Each Electronic Annunciator shall have provision for connection with accept/ reset/ lamp test/mute Push buttons for proper functions.
- c) Electronic annunciator shall have provision for connection with Electronic Buzzer/ Hooter for Trip & Electronic Bell for Non-Trip Audio Alarm of common annunciation scheme.
- d) Electronic Annunciation shall have provision for flashing illuminating display with inscription for operation of respective Protection Relay.
- e) The Micro-Processor based Electronic Annunciator should have separate coloured windows for Trip & Non-Trip Annunciation for easy detection.
- f) Annunciator fascia units shall have translucent plastic windows for each alarm point.
- g) Electronic Annunciator shall have first Fault Indication Facilities & System Watch Dog
- h) Annunciator fascia plate shall be engraved in black lettering with respective alarm inscription as specified. Alarm inscriptions shall be engraved on each window in not more than three lines and size of the lettering shall be about 5 mm. The inscriptions shall be visible only when the respective fascia LED will glow.
- i) Annunciator fascia units shall be suitable for flush mounting on panels. Replacement of individual fascia inscription plate and LED shall be possible from front of the panel.
- j) Unless otherwise specified, one alarm bell meant for non-trip alarms and one hooter meant for trip alarms shall be provided in each panel (mounted inside).
- k) Each annunciator shall be provided with 'Accept', 'Reset' and 'Test' push buttons, in addition to external Push Button for the same.
- l) Special precaution shall be taken by the manufacturer to ensure that spurious alarm



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conditions do not appear due to influence of external magnetic fields on the annunciator wiring and switching disturbances from the neighboring circuits within the panels.

- m) In case 'RESET' push button is pressed before abnormality is cleared, the LEDs shall continue to glow steadily and shall go out only when normal condition is restored.
- n) Any new annunciation appearing after the operation of 'Accept' for previous annunciation, shall provide a fresh audible alarm with accompanied visual alarm, even if the process of "acknowledging" or "resetting" of previous alarm is going on or is yet to be carried out.
- o) Visual and audible annunciation for the failure of D.C supply to the annunciation system shall also be provided and this annunciation shall operate on a 230 Volts AC supply with separate fuses. A separate voltage check relay (adjustable setting) for the failure of supply shall be provided and if the failure of supply exists for more than 2 to 3 sec, a facia shall light up and the bell shall sound. A separate push button shall be provided for cancellation of this bell alone but the facia window shall remain steadily lighted till the supply to the annunciation system is restored.
- p) The sound of the audible alarm (bell) provided for this annunciation shall be different from the audible alarm for warning signals.
- q) The annunciation system shall be capable of catering for at least 20 simultaneous signals at a time.
- r) One self-resetting push button shall be provided each for testing emergency annunciation and warning annunciation systems and for testing, the annunciation supply failure monitoring circuit. One self-resetting push button shall also be provided on each panel for testing the facia window lamps. These testing circuits shall be so connected that while testing is being done it shall not prevent the registering of any new annunciation that may land during the test.
- s) Provision shall be made for switching off the entire annunciation system.
- t) The self returning push buttons for Accept, Sound cancel and lamp test shall be common for both emergency and warning annunciations.
- u) The annunciation shall be of repetitive type and shall be capable of registering the fleeting signals. Minimum duration of the fleeting signals registered by the system shall be 15 milli seconds.





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**29) SPACE HEATERS**

- a) 240 V, 50 HZ Tubular Space Heaters suitable for connection to the Single Phase A.C. shall be controlled by a suitably rated single pole miniature circuit breaker compartment to be mounted on an insulator
- b) These shall not be mounted close to the wiring or any panel mounted equipment.
- c) The Watt loss per Unit surface of heater shall be low enough to keep surface temperature well below sensible heat but should be capable to keep 10°C above average ambient temperature in the rainy season but temperature shall not under any circumstances damage the insulation of wiring of the panel / other mounted equipments.
- d) A thermostat control unit with variable temperature shall be installed to control the heater.
- e) Wiring connected to space heaters in the cubicle shall have porcelain beaded insulation over a safe length from heater terminals.

**30) Interior Lighting and Receptacles**

- a) The LV Chamber shall be illuminated by 11W LED lamp with fixture including reflector, front cover, etc connected to 230 Volt Single Phase A.C.
- b) The illumination of the interior shall be free from shadows and shall be planned to avoid any strain or fatigue to the wireman likely to be caused due to sub-normal or non-uniform illumination.
- c) A toggle switch or door operated switch shall be provided for control of A.C. lighting in each panel.
- d) One combined 15 Amps. 3-Pin and 5 Amps. 2-Pin Power Socket outlet together with Plus Pins shall be provided at convenient points in LV Chamber I for A.C. Supply.

**31) MCBs, Switches, Fuses and Links**

- a) Each panel shall be provided with necessary arrangements for receiving distribution, isolating and tripping of D.C and A.C supplies for various control, signaling, lighting and space heater circuit in an easily accessible location.
- b) The incoming and sub-circuits shall be separately provided with MCBs of suitable rating with auxiliary contacts that are extended for trip indication in each panel.



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- c) Selection of the main and sub-circuits ratings shall be such as to ensure selective clearance of sub-circuit faults.
- d) All MCBs, Fuses and Links shall be of superior quality , bear ISI mark and shall have imprint of rating, voltage and circuit designation.

## 32) TESTS

### 32.1 Type Test

- a) The Manufacturer should submit the Type test certificate including **IP test of Panels and functional test** for all the protective relays carried out within **10 years as specified by CEA guidelines(as approved by KSEBL)** from the due date of submission of tender from CPRI/ NABL accredited Laboratory (or accreditation based on ISO/ IEC/ Guide 25/ 17025 or EN 45001 by the national accreditation body of the country where the lab is located.) / PHELA/KERI/KEMA/CESI laboratory /Govt. Recognized test house or Laboratory on the **tendered Items** as per IS/IEC/Technical specification with the tender documents.
- b) Following type test reports are to be submitted for the offered equipments. The tests shall be carried out with the same make and type of Vacuum Interrupter bottle offered in the bid.
  - 1) Lightning Impulse Voltage Withstand test
  - 2) HV dry 1minute Power frequency withstand test.
  - 3) Short time (25kA 3Sec) and Peak withstand current test
  - 4) Short circuit Test duties on Circuit Breaker.
  - 5) Temperature Rise Test.
  - 6) Internal Arc Test IAC AFLR 25KA/1 sec for CB compartment, cable compartment and busbar compartment as per IEC 62271-200.
  - 7) Type Test to prove Endurance E2 M2 C2
  - 8) Degree of Protection.

All the relevant test reports in support of the test conducted in line with relevant standards shall be submitted for the type test certificate attached.

- c) Valid Type Test Certificate of PT, CT, Neutral CT and Relays shall also be submitted.

### 32.2 INSPECTION AT FACTORY

- a) Acceptance test at manufacturer's works in presence of purchaser's representatives shall be carried out. The supplier shall give at least 20 days notice of the date when



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the tests are to be carried out. Purchasers shall give the right to select any quantity of the item wise offered lot for testing, offered for inspection and in the event of failure in test(s), the purchaser shall have the right to reject the offered equipments.

- b) All components, relays, meters & annunciators provided in the panels are to be accepted only after successful hundred percent performance testing at testing department, if found required, by KSEBL.
- c) The inspection may be carried out by the KSEBL at any stage of manufacturing. The successful Manufacturer shall grant free access to the KSEBL's representative/s at a reasonable notice when the work is in progress. Inspection and acceptance of any equipment under this specification by the KSEBL, 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.
- d) The manufacturer shall keep the KSEBL informed in advance, about the manufacturing programme so that arrangement can be made from stage inspection.
- e) The KSEBL reserves the right to insist for witnessing the acceptance/routine testing of the bought out items. The supplier shall keep the KSEBL informed, in advance, about such testing programme.
- f) **Test at Factory:- Test procedures shall be forwarded along with inspection call.** The following Tests shall be carried out 6 copies of Test certificates shall be submitted for approval.
- g) The complete switchgear shall be subjected to routine tests as specified in the relevant standards mentioned in clause 2 of Annexure I, Part II. All equipments procured by the supplier shall be accepted only after conducting acceptance test/witnessing of tests by the bidder's representative.
- h) The individual components Viz. Circuit Breakers, CTs, PTs, relays and instruments shall also be subjected to routine tests as specified in the relevant standards mentioned in clause 2 of Annexure I, Part II during Factory Acceptance Test by KSEBL representative.
- i) **The Equipments shall only be dispatched after approval of the test certificates and issue of Material Despatch Cum Clearance (MDCC) from KSEBL.**
- j) **Inspection and Testing Plan: To be submitted in advance and get approved before Factory Acceptance Test.**

**33) DRAWINGS/DOCUMENTATION**

- 33. 1.** The bidder shall furnish as a part of their offer, complete set of technical literature/catalog and manuals and one set of typical GA/ Schematic drawings in respect of all the control and protection equipment/schemes offered by them.

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- 33.2** In the event of an order materializing , within 2 weeks of the receipt of order, Triplicate copies of the following drawings and literature shall be submitted
- a) Principal dimension details of each unit cubicles, complete assembly of panel.
  - b) Front and rear views of the Panel with instrument and device positions marked.
  - c) Foundation drawings and floor plans of panels. Location of foundation bolts, cable slots and weights shall also be given on these drawings.
  - d) Pictorial views of the Control Switches Terminal Blocks, Indication Instruments, Test Blocks and exploded views of draw out type instructions and Fuse Blocks.
  - e) Schematic Wiring Diagram for Test Terminal Block.
  - f) Illustrative, descriptive literature, General Technical Data & Specification of Devices.
  - g) Make, type, particulars, literatures of each and every relay (protective & auxiliary), meters, annunciators, switches, lamps, TBS, TTBS, etc. along with bill of material in line with specification.
  - h) Contact development drawings of all switches, relays etc.
  - i) Internal wiring diagrams and wire wise schedule of the panels i.e. instruments, relays, meters, annunciation and other equipment showing external wiring terminations also.
  - j) Schematic diagram with detailed item-wise bill of material including make, type / model no, rating etc for all devices in the switchboard and supplied loose.
  - k) Trip Matrix and Inter locking Schemes.
  - l) Protection and metering single line diagram for each panel.
  - m) Complete AC and DC Schematic drawings of elements of panels. These show all A.C. power connection and secondary connection for relay, meters etc. with vector relationship.
  - n) Complete schematic drawings for annunciation system.
  - o) Cable inter-connection drawings indicating terminal block numbers, number of cores, instruments, panels at which cable is to be connected etc. The supplier may submit any other drawings considered necessary in addition to the drawings stated above.
  - p) Name plate and equipment identification label



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- 33.3** Normally drawing approval shall be granted within 30 days from receipt of the drawings.
- 33.4.** 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 purchasing authority. All manufacturing work which is not as per the approval shall be at the suppliers risk.
- 33.5.** All drawings shall conform to International standards Organization (ISO) 'A' series of drawing sheet. All drawings shall be in indelible ink. All dimensions and data shall be in S.I.Units.
- 33.7.** Before dispatch of equipment to various consignees, the supplier shall furnish 6 sets of drawings, Bill of materials, wiring Schedule, technical literature and operating instruction & commissioning Manuals in suitable files (hard copy as well as soft copy)
- 1) 2 sets per Panel Board shall be sent to concerned substation.
  - 2) 2 sets per Panel Board shall be sent to consignee before the dispatch of equipment.
  - 3) 1set per Panel Board shall be sent to Purchase Authority.
  - 4) 1 set shall be provided inside the panel.
- 33.8.** Supplier shall also furnish **one complete set of soft copy of the relevant "AS BUILT" drawings in CD/USB drive.** These shall be furnished to CE (SCM),immediately after the final inspection of various equipments before dispatch.
- 33.9.** Approval of drawings/work by purchaser shall not relieve the supplier of his responsibility and liability for ensuring correctness and correct interpretation of the drawings for meeting the requirements of the latest revision of application standards, rules and codes of practices. The equipment shall conform in all respects to high standards of engineering, design, workmanship and latest revision of relevant standards at the time of ordering and purchaser shall have the power to reject any work or materials which, in his judgement is not in full accordance therewith.

**34) Software for IEDs/Numerical Relays/Meters**

Full version of relay communication software with all features including software for Disturbance Record Analyser, licensed to KSEB Ltd. for relay testing & commissioning shall be provided in CD/USB DRIVE which shall also be used for subsequent installation if needed. The software shall unication software.

Licensed copy of communication software, front & rear interfacing cables and hardware shall be supplied to upload/ download the data to/from the relay and from/to the



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laptop. The software shall be suitable for operations like switching, setting changes, analysis of fault record and to retrieve oscillographic fault data from the relay, as applicable.

Any future up-gradation in software/ firmware shall be provided with free of cost.

**35) PACKING AND FORWARDING**

1. The equipments shall be packed in crates suitable for vertical/horizontal transport as the case may be, and suitable to withstand handling during transport and outdoor storage during transit. The supplier shall be responsible for any damage to the equipment during transit, loading and unloading due to improper and inadequate packing. The easily damageable material shall be carefully packed and marked with the appropriate caution symbol. 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 supplier without any extra cost.
2. Each consignment shall be accompanied with a detailed packing list containing the following information.
  - a) Name of consignee
  - b) Details of consignment-P.O/Name of Item/SI.No.,etc
  - c) Destination
  - d) Total weight of consignment
  - e) Sign showing upper/lower side of the crate
  - f) Handling and packing instructions
  - g) Bill of material indicating contents of each package
3. The supplier shall ensure that the packing list and bill of material are approved by the purchaser before dispatch.

**36) SCHEDULE OF EQUIPMENTS:-**

**36.1 Incomer Panel Bus Bar 2000A [or 1250A]\***

\*( For 1250A Bus Bar rating panel difference in requirement is given within [ ...])

Sl. No.	Description	Qty.	Recommended make
1.	<b>Circuit Breaker</b> Vacuum Interrupters 12kV, <b>2000A or [1250A]</b> ,25kA 3s- 3Nos with 230V AC motor operated, spring charged Closing/Tripping mechanism with facility also for manual charging of spring with Anti	1set	Vacuum Interrupter bottle: ABB/ALSTOM



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	pumping feature, Auxiliary Switch with 6 NO + 6 NC contacts Shunt Trip coil rated for 110 V DC Manual CLOSE/OPEN Push Button, Electrical Release for close, Mechanical ON/OFF Indicator		CROMPTON GREAVES/BEL/SIEMENS
2	Breaker Control switch	1	KAYCEE/RECOM/ SWITRON
3	LOCAL/ REMOTE Switch with three sets of contacts	1	KAYCEE/RECOM/ SWITRON
4	5 Core Current Transformers of ratio <b>1200/5-5-1-1-1A or [800-400/ 5-5-1-1-1A]</b> with output and accuracy class as follows. Core 1 : 15 VA / 5 P10 Core 2 : 10 VA / 0.5 S Core 3 : PS Core 4 : PS Core 5 : PS	3	ECS/Pragati/ Gemini/ CG/ ABB/ Intrans/ Intrans/ Resitech/vidyuth
5	Potential transformer, 3nos single phase or one 3 phase star connected for transformer ratio 11kV/ $\sqrt{3}$ / 110V/ $\sqrt{3}$ , output 100 VA, class 0.5, connected to the cable side mounted above the panel suitable for measuring incoming voltage complete with HV fuses and LV fuses.	1set	ECS/Pragati/ Gemini/ CG/ ABB/ Intrans/ Intrans/ Resitech/vidyuth
6	Ammeter <b>0-1200A or [0-400-800A]</b> 5A , class 1, 96 X96 mm.	3	AE/MECO/IMP/RISHAB
7	Digital voltmeter 0-12 kV,48 x96 mm, LED display with 2 decimals, self powered, class 1	1	AE/MECO/IMP/RISHAB
8	Voltmeter Selector Switch	1	KAYCEE/RECOM/ SWITRON
9	TOD meter, Accuracy 0.5S		L&T/SECURE
10	Breaker 'ON' RED indicating lamp	1	DAV/TEKNIC/ESSEN
11	Breaker 'OFF' GREEN indicating lamp	1	
12	'Spring Charged' BLUE indicating lamp	1	
13	'AUTO TRIP' AMBER indicating lamp	1	

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14	'DC control supply fail' Yellow indicating lamp	1	
15	'Service Position' Blue indicating lamp		
16	'Test Position' White indicating lamp	1	
17	'Trip Circuit Healthy' White indicating lamp		
18	PT Supply R Y B RED YELLOW BLUE indicating lamp	1 set	
19	Numerical REF Relay with Stabilising resistor (Variable 0-1000 Ohm)& Metrosil	1	ABB/ALSTOM/GE/SEL/SCHNEIDER -MICOM/ *SIEMENS
20	5A, Numerical IDMT/DT relay with 3 over current and 1 earth fault	1	ABB/ALSTOM/GE /SEL/SCHNEIDER -MICOM/ *SIEMENS
21	Sensitive Earthfault Relay (If feature is not inbuilt in O/C & E/F Relay)	1	ABB/ALSTOM/GE/SEL/SCHNEIDER -MICOM/*SIEMENS
22	Master trip relay	1	ABB/ALSTOM/GE/ *SIEMENS
23	TC Supervision relay	1	ABB/ALSTOM/GE/ *SIEMENS
24	DC Supply Supervision relay	1	ABB/ALSTOM/GE/ *SIEMENS
25	ON/OFF switch for AC & DC supply, 2 pole rotary	2	KAYCEE/RECOM/ SWITRON
26	AC outlet socket.	1	ANCHOR
27	Control Circuit MCBs	1 set	BUSSMAN/Schneider
28	Space heater with thermostat & control switch	2	GIREESH/APTS
29	Panel illumination lamp with door switch	1	PHILIPS/BAJAJ
30	TTB for TOD meter	1	IMP/AE/DAV/JVS
31	Terminal Block 1100V Grade	1 set	Elmex /Connectwell
32	Capacitive Voltage indicator for monitoring whether the Cable is Live or Dead	1 set	ECS/NPT
33	Emergency Pushbutton	1	DAV/TEKNIC/ESSEN
34	Micro processor based, facia annunciator 8 windows, with hooter, bells, accept, reset , Lamptest, etc.	1 set	ALAN/BHARANI
35	Accept, Reset, Test Pushbutton for Annunciator	3	DAV/TEKNIC/ESSEN





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36	Outdoor resin cast Neutral CT ratio <b>1200/1A</b> or <b>[800-400/ 1A]</b> PS Class, V <sub>kp</sub> ≥300V R <sub>ct</sub> 2.5 ohms @ 75 C, I <sub>mag</sub> @ V <sub>kp</sub> /2 60-80 mA	1	ECS/Pragati/ Gemini/ CG/ ABB/ Intrans/ Intrans/ Resitech/vidyuth/ vidyuth
37	Inter tripping Scheme for REF relay	1 set	ABB/ALSTOM/GE/ *SIEMENS

\* In the case of SIEMENS make of relays , 7SR series is not acceptable.

**36.2 Outgoing Feeder [ or Station Aux Transformer ]\* Panel**

\*( For Station Aux Transformer panel requirement is given within [ ...])

Sl. No	Description	Qty.	Recommended make
1.	<b>Circuit Breaker</b> Vacuum Interrupters 12kV, <b>630A</b> ,25kA 3s- 3Nos with 230V AC motor operated, spring charged Closing/Tripping mechanism with facility also for manual charging of spring with Anti pumping feature, Auxiliary Switch with 6 NO + 6 NC contacts Shunt Trip coil rated for 110 V DC Manual CLOSE/OPEN Push Button, Electrical Release for close, Mechanical ON/OFF Indicator	1set	Vacuum Interrupter bottle: ABB/ALSTOM SIEMENS/ CROMPTON GREAVES/BEL
2	Breaker Control switch	1	KAYCEE/RECOM/ SWITRON
3	LOCAL/ REMOTE Switch with three sets of contacts	1	KAYCEE/RECOM/ SWITRON
4	2 Core Current Transformers of ratio <b>400-200/5-5 A</b> <b>[or 200-100/ 5-5 A]</b> with output and accuracy class as follows. Core 1 : 15 VA / 5 P10 Core 2 : 10 VA / 0.5 S	3	ECS/Pragati/ Gemini/ CG/ABB/ Intrans/ Intrans/ Resitech/vidyuth
5	Ammeter <b>0-200-400A [or 0-100-200A]</b> 5A , class 1, 96 X96 mm.	3	AE/MECO/IMP/RISHAB

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6	TOD meter, Accuracy 0.5S		L&T/SECURE
7	Breaker 'ON' RED indicating lamp	1	DAV/TEKNIC/ESSEN
8	Breaker 'OFF' GREEN indicating lamp	1	
9	'Spring Charged' BLUE indicating lamp	1	
10	'AUTO TRIP' AMBER indicating lamp	1	
11	'Service Position' Blue indicating lamp		
12	'Test Position' White indicating lamp	1	
13	'Trip Circuit Healthy' White indicating lamp		
14	5A, Numerical IDMT/DT relay with 3 over current and 1 earth fault	1	ABB/ALSTOM/GE/ SEL/SCHNEIDER - MICOM/*SIEMENS
15	Sensitive Earthfault Relay (If feature is not inbuilt in O/C & E/F Relay)	1	ABB/ALSTOM/GE/ SEL/SCHNEIDER - MICOM/*SIEMENS
16	Master trip relay	1	ABB/ALSTOM/GE/ *SIEMENS
17	TC Supervision relay	1	ABB/ALSTOM/GE/ *SIEMENS
18	ON/OFF switch for AC & DC supply 2 pole rotary	2	KAYCEE/RECOM/ SWITRON
19	AC outlet socket.	1	ANCHOR
20	Control Circuit MCBs	1 set	BUSSMAN/Schneide
21	Space heater with thermostat & control switch	2	GIREESH/APTS
22	Panel illumination lamp with door switch	1	PHILIPS/BAJAJ
23	TTB for TOD meter	1	IMP/AE/JVS/DAV
24	Terminal Block 1100V Grade	1 set	Elmex /Connectwell
25	Capacitive Voltage indicator for monitoring whether the Cable is Live or Dead	1 set	ECS/NPT
26	Emergency Pushbutton	1	DAV/TEKNIC/ESSEN

\* In the case of SIEMENS make of relays , 7SR series is not acceptable.



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**36.3 Bus Coupler Panel Bus Bar 2000A or [1250A]\***

\*( For 1250A Bus Bar rating panel requirement is given within [...])

Sl. No.	Description	Qty.	Recommended make
1.	<b>Circuit Breaker</b> Vacuum Interrupters 12kV, <b>2000A or [1250A]</b> ,25kA 3s- 3Nos with 230V AC motor operated, spring charged Closing/Tripping mechanism with facility also for manual charging of spring with Anti pumping feature, Auxiliary Switch with 6 NO + 6 NC contacts Shunt Trip coil rated for 110 V DC Manual CLOSE/OPEN Push Button, Electrical Release for close, Mechanical ON/OFF Indicator	1set	Vacuum Interrupter bottle: ABB/ALSTOM SIEMENS/ CROMPTON GREAVES/BEL
2	Breaker Control switch	1	KAYCEE/RECOM/SWITRON
3	LOCAL/ REMOTE Switch with three sets of contacts	1	KAYCEE/RECOM/SWITRON
4	Digital voltmeter 0-12 kV,48 x96 mm, LED display with 2 decimals, self powered, class 1	1	AE/MECO/IMP/RISHAB
5	Voltmeter Selector Switch	1	KAYCEE/RECOM/SWITRON
6	Breaker 'ON' RED indicating lamp	1	DAV/TEKNIC/ESSEN
7	Breaker 'OFF' GREEN indicating lamp	1	
8	'Spring Charged' BLUE indicating lamp	1	
9	'DC control supply fail' Yellow indicating lamp	1	
10	'Service Position' Blue indicating lamp		
11	'Test Position' White indicating lamp	1	
12	PT Selection scheme relays ( PT Selection scheme shall be designed according to the Panel Set required for each Station as per Schedule of Requirement in Part I Section E- Format D)	1set	ABB/ALSTOM/GE SCHNEIDER/*SIEMENS
13	DC Supply Supervision relay	1	ABB/ALSTOM/GE/ *SIEMENS
14	ON/OFF switch for AC & DC Supply 2 pole rotary	2	KAYCEE/RECOM/SWITRON



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15	AC outlet socket.	1	ANCHOR/Superior
16	Control Circuit MCBs	1 set	BUSSMAN/Schneider
17	Space heater with thermostat & control switch	2	
18	Panel illumination lamp with door switch	1	PHILIPS/BAJAJ
19	Terminal Block 1100V Grade	1 set	Elmex /Connectwell
20	Emergency Pushbutton	1	DAV/TEKNIC/ESSEN
21	Micro processor based, facia annunciator 8 windows, with hooter, bells, accept, reset , Lamp test, etc.	1 set	ALAN/BHARANI
22	Accept, Reset, Test Pushbutton for Annunciator	3	DAV/TEKNIC/ESSEN

**\* In the case of SIEMENS make of relays , 7SR series is not acceptable.**

Only recommended makes of Relays, Energy Meters and Vacuum Interrupter Bottles are acceptable. For other items makes other than recommended ones are subject to approval of purchasing authority during drawing approval subject to verification of type test reports.

**36.4 ANNUNCIATOR FACIA ARRANGEMENT:**

(Facia inscription details will be finalised during Drawing Approval)

SPARE	SPARE	SPARE	DC SUPPLY FAIL
SPARE	SPARE	SPARE	AC SUPPLY FAI

Any item though not specifically mentioned above but necessary for operation and maintenance of the equipment (including provision for contact multiplication, auxiliary relays, timers, supply selection, etc) as per technical requirements / standards/ standard practices are within the scope of the contract.

**36.5 List of Special Tools (To be provided in each Station/ with every 10 Panel Set)**

1. Spring Charging Handle
2. Breaker withdrawal tool and Ramp
3. Earthing Truck.

**37) Busbar & Circuit Breaker ratings**

Transformer Capacity -->	Up to 16 MVA	16 MVA & 20MVA
Incomer CB (A)	1250	2000
Bus Coupler CB (A)	1250	2000



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Outgoing Feeder Panel CB (A)	630	630
Aux Trfr Feeder Panel CB (A)	630	630

**38) LIST OF SPARES TO BE PROVIDED**

(in each station or with every 10 panel set ):

SI.No	DESCRIPTION	QTY
1	CB Closing & Tripping coil	3 set each
2	CB Truck assembly complete for 2000A[or 1250A]	1 set
3	Vacuum Interruptor Bottle	3 nos.
4	Supporting insulator for one pole	1 set
5	CB Auxiliary contact	1 set
6	3 O/C + E/F Relay with SEF protection	1 set
7	Master trip relay	3 no.
8	REF Relay	1 no.
9	LED Indicating lamp with assembly	3 sets
10	Ammeter	3 nos.
11	Voltmeter	3 nos.
12	TOD Energy meter	1 no.
13	Annunciator	1no.
14	TTB	1 no.
15	CT suitable for Incomer panel	3 Nos
16	CT suitable for Outgoing panel	3 Nos
17	PT single pole with fuse	3 nos.
18	PT Fuse	3 nos.

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**Annexure – I(B)**

**GUARANTEED TECHNICAL PARTICULARS**

**(Technical Particulars of Type tested item/ model which is offered as per the technical specification of this tender shall be furnished)**

Sl. No.	Description	Particulars
<b>1</b>	<b>PANEL DETAILS</b>	
a	Make	
b	Type Designation	
c	Applicable Standards	
d	Details of separate compartments provided.	
e	Compartments for which Pressure relief valves provided	
<b>2</b>	<b>VOLTAGE RATINGS</b>	
a	Rated Voltage & Frequency	
b	Power Frequency Withstand voltage	
c	Impulse withstand voltage	
<b>3</b>	<b>CURRENT RATINGS</b>	
a	Normal Current rating	
b	Short time current rating 3 second	
c	Short time current rating 1 second	



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d	Short Circuit Making Current	
e	Rupturing capacity	
<b>4</b>	<b>CONSTRUCTION</b>	
a	Partition Class	
b	Loss of Service Continuity Class	
c	Degree of Protection	
d	Whether satisfying Intenal Arc Classification IAC AFLR 25kA, 1 sec.	
e	Operating Speed of breaker in metre per sec.	
f	Minimum distance between live parts and earthed metals (in mm)	
g	Minimum distance between Phase (in mm)	
h	Power to trip breaker Electrically at 110V	
i	Type of contact (Main & Auxiliary)	
j	Type of bushing / insulator (indicate creepage distance in mm)	
k	Dry flashover in kV (rms)	
l	Travel of contact in mm	
m	Material of insulation between break poles	
n	Impulse flash over in kV (Peak)	
o	Estimated puncture value of insulator in kV	
p	Drive mechanism employed between operating mechanism	
q	Weight of complete three phase breaker with operating mechanism bushing & frame work	



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r	Thickness of sheet metal used for panels in mm	
s	Whether seven tank processing done as per spec , on sheet metal.	
t	Type of finishing paint	
u	Thickness of powder coating	
v	No. of Mechanical Operations	
w	Closing/ Tripping coil Supply	
x	Spring Charging Motor Supply	
y	Auxiliary Contacts	
z	Whether E2 M2 C2 compliant as per spec & Type test report submitted?	
<b>5</b>	<b>VCB</b>	
a	Make of Interrupter	
b	Type Designation	
c	Rated Current	
d	Applicable Standard	
e	Operating Sequence (Duty cycle)	





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f	Opening Time (ms)		
g	Break Time (ms)		
h	Contact resistance		
i	Whether VCB interruptors are fully encapsulated		
j	Life expectancy under normal condition ( in years)		
k	Whether Type Test Report Submitted		
<b>6</b>	<b>PANEL SHELL</b>	<b>Incomer</b>	<b>Outgoing</b>
a	Make		
b	Dimension (WxDxH) in mm		
c	Height of Panel alone in mm		
d	Height of Panel with Internal Arc Routing Baffles (in mm)		
e	Height of Panel with closed pressure relief duct (in mm)		
f	Clearance required on Front, Rear, Right and Left for operation of equipment (in mm)		
g	Clearance required on Front, Rear, Right and Left for replacement of equipment (in mm)		
g	Panel weight (in Kg)		
h	Panel weight including Packing (Kg)		



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<b>7(a) Current Transformer</b>		
a	Make	
b	Type , Model No.	
c	Ratio	
d	Class of Accuracy/VA	
e	Continuous percent overload	
f	1 Sec. Over-current rating	
g	Knee point voltage (min)	
h	Maximum exciting current	
i	Class of Insulation E or better	
j	Whether CT Secondary terminals are easily accessible for testing by removing back door.	
k	Whether Type Test Report Submitted	
<b>7(b) Potential Transformer</b>		
a	Make	
b	Type & Model No.	
c	Ratio	
d	Rated burden (VA per phase)	



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e	Class of Accuracy		
f	PT Location		
g	Whether Withdrawable type , furnish details		
h	PT Fuse type, Make,rating, replacement details, etc		
i	Whether Type Test Report Submitted		
<b>8</b>	<b>NEUTRAL CT</b>		
a	Make		
b	Type: Cast Resin/ Oil		
c	Class of Insulation		
d	Model No:		
e	Ratio		
f	Class of Accuracy		
g	Minimum Knee Point Voltage		
h	Maximum excitation current at $V_k/2$		
i	Secondary Resistance at 75°C.		
j	Whether Type Test Report Submitted		



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<b>9</b>	<b>BUS BAR</b>		
a	Material		
b	Size of Main Bus & Current Density		
c	Current Rating of Bus		
d	Short time current rating		
e	Size of Dropper & Current density		
f	Current rating of Dropper		
g	HT Sleeve : make		
h	Whether Bus Bar Supported or self supported.		
i	Bus Bar Support material		
j	Whether PVC Sleeve used		
k	Confirm that for bus bar joints, dropper connections and CT connections, there shall be minimum four bolts per joint.		
<b>10</b>	<b>INDICATING LAMPS</b>		
a	Make		
b	Type / Model & body material		



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c	Operating Voltage (Volts)		
d	Size of lens (mm)		
e	Wattage of LEDs(Watts)		
f	Colour of LED covers		
g	LED Replacement method		
h	Whether Series connected Resistance provided		
i	Whether Integral engraved plate provided.		
<b>11</b>	<b>SPACE HEATER/ THERMOSTAT</b>		
a	Make of space heater		
b	Rating V, Hz, W		
c	Thermostat Make		
d	Thermostat Rated Voltage, Temp Setting Range		
<b>12</b>	<b>TEST BLOCK</b>		
a	Make ( For Energy Meter)		
b	Type / Model ( For Energy Meter)		



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c	Make ( For Relays)		
d	Type/ Model ( For Relays)		
<b>13</b>	<b>PUSH BUTTON</b>		
a	Make		
b	Type(Microprocessor Based or not) /Model		
c	Body/ Case : Metallic or not		
d	Contact Type (Momentary/ Maintained)/Material		
e	Whether shrouding provided to prevent in advertent operations?		
f	Number of No/NC Contacts		
g	Making / Carry Current		
h	Breaking Current		
<b>14</b>	<b>Interior Lighting and Receptacle</b>		
a	Interior lighting make/Type/ Rating		
b	Whether Door Switch for light provided/ Make/Type		
c	Universal Multi pin socket (15A) Make/ Rating		



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d	Whether ISI marked		
<b>15</b>	<b>Fuses and MCB</b>		
a	Make of MCB		
b	Whether MCB is ISI marked		
c	Make of Fuse/ Links		
d	Whether Fuses are ISI marked		
<b>16</b>	<b>Annunciation System (Micro controller based)</b>		
a	Make		
b	Type and Model No.		
c	No. of Windows & window dimension in mm		
d	Dimension (LxWxD) in mm		
e	Supply Voltage		
f	Permissible Voltage variation		
g	Power Consumption per window		
h	Fault input contact (Potential Free NO/NC)		



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i	Minimum duration of impulse for initiating contact		
j	Contact Rating of auxiliary relay provided.		
k	Flickering speed of windows		
l	Whether AC Failure and DC Failure feature included		
m	Is the sequence of operation as per specification		
n	Push Buttons for Emergency/ Warning test: Integral or External.		
o	Buzzer/ Hooter: Integral or External- If external they shall be provided		
<b>17</b>	<b>EARTHING</b>		
a	Size of Earth Bus Bar		
b	Material of Earth Bar		
c	Conductor size for earth connection from body of component devices		
d	Colour of earthing wire		
<b>18</b>	<b>PANEL WIRING</b>		
a	Name of Cable Manufacturer		
b	Type and Designation of Cable		





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c	Conforming Standard		
d	Whether PVC insulated FRLS cable used		
e	Voltage Grade of Cable		
f	No. of Cores/ Stranded or not/ Tinned Copper or not		
g	Size of conductor for Auxiliary AC Supply		
h	Size of conductor for CT /PT/DC Aux. Circuit		
i	Size of conductor for other Circuits		
j	Type of terminals provided on wiring		
<b>19</b>	<b>TERMINAL BLOCK</b>		
a	Name of Manufacturer		
b	Type and Model of Terminal Block		
c	Type and Model of Terminal Block for PT		
d	Type and Model of Terminal Block for CT		
e	Conforming Standard		
f	Voltage Grade (1100V required)		



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g	Continuous Current Rating in A		
h	Material used		
i	Maximum no. of cables that can be connected		
j	% & Number of spare terminals provided		
k	Transparent removable covers provided or not		
<b>20</b>	<b>NAME PLATE AND MARKINGS</b>		
a	Material of Name Plate & Colour		
b	Letters Punched or Engraved		
c	Whether Identification label as per specification provided.		
<b>21</b>	<b>CIRCUIT BREAKER CONTROL SWITCH</b>		
a	Make		
b	Model		
c	Whether Spring Return to Neutral with lost motion device and locking facility		
d	No. of positions		



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e	Type of handle		
f	No. of ways in each position		
g	Making & Breaking capacity of contacts		
h	No. of mechanical operations		
i	Whether locking arrangement provided or not		
<b>22</b>	<b>LOCAL/REMOTE SELECTION SWITCH</b>		
a	Make		
b	Model		
c	Whether Stay put type		
d	No. of positions		
e	Type of handle		
f	No. of ways in each position		
g	Making & Breaking capacity of contacts		
h	No. of mechanical operations		
<b>23</b>	<b>Ammeter</b>		



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Doc. #: **SCM-SPEC/XT/11kV Indoor VCB Panel**

Rev.#: 0

Effective Date 31/05/2021

a	Make		
b	Type & Model No.		
c	Conforming Standard		
d	Rated Current		
e	Size		
f	Accuracy		
g	CT Ratio		
h	Scale Ranges		
i	Additional Dial		
j	Burden		
<b>24</b>	<b>Voltmeter</b>		
a	Make		
b	Type & Model No.		
c	Conforming Standard		



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d	Rated voltage/ Burden/ Accuracy		
e	Size		
f	Size of Digits/No. of Digits/No. of decimals		
g	Whether super bright LEDs used		
h	Maximum Value of Voltage Scale		
<b>25</b>	<b>TOD ENERGY METER</b>		
a	Make		
b	Model No.		
c	Type (3 ph, 3 Element, 4 wire)		
d	Accuracy		
e	Rated voltage/ Current		
f	VA Burden of CTs/PTs		
g	Display Parameters		
h	No. of modes of display		
i	Maximum No. of decimal places in Mode 3		



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j	Whether retain last recorded reading in case of power failure/ Furnish details		
k	Whether display both import and export		
l	Whether having Data logging and data retrieving facility/ Furnish details		
m	Temperature compensation provide or not		
n	Direct reading or use of Multiplication factor required/ If required MF		
o	No. of Digits provided and whether sufficient for 1000 hrs of operation/Furnish details		
p	Whether current coil have continuous overload capacity of 200% for both accuracy and thermal limits		
q	Whether current coil shall withstand at least 10 times the rated current for 0.5 second with out loss of accuracy		
r	Transmitting contacts available or not. Impulse rate/ whether suitable for remote indicating or summation/Furnish details		
s	Communication port/ protocol/ data transfer rate Whether conforming to tender spec. / Furnish details.		
t	Whether DLMS compliant		
<b>26</b>	<b>3 OVERCURRENT &amp; EARTH FAULT RELAY</b>		



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a	Make		
b	Model No.		
c	Type		
d	Current Rating		
e	Whether Separate LEDs provided for R,Y, B & E faults		
f	Whether IEC 61850 Compliant		
g	Communication Ports provided		
h	Whether self supervision facility provided.		
i	Characteristic curve		
j	TMS for IDMT O/C and E/F		
k	IDMT O/C Protection current setting		
l	IDMT E/F Protection current setting		
m	High Set (50 & 50N) current setting		
n	No. of Digital input/ Output		



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o	No. of Events stored		
p	Whether Local Breaker Backup feature available and wired.		
q	No. of fault records stored		
r	No. of voltage inputs in Relay (3 nos. required)		
s	Whether Type Test report submitted?		
<b>27</b>	<b>REF RELAY</b>		
a	Make		
b	Model No.		
c	Type: Numerical , High Impedance		
d	Current Rating & Aux Voltage		
e	Type of indicator resetting facility		
f	Operating time (ms)		
g	Setting Range		
h	Contacts		
i	Variable Stabilising Resistor value ( $\Omega$ )/Wattage(W), Make		





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j	Details of Metrosil provided Make, Rating, Model No.		
l	Communication Ports provided		
k	Whether REF relay is wired to initiate disturbance recorder of 3 over current earth fault relay in the event of operation?		
l	Whether Type Test report of Relay submitted?		
<b>28</b>	<b>Trip Circuit Supervision Relay</b>		
a	Makers name		
b	Type and Model Name		
c	Aux Voltage (Volts)		
d	Number of contacts	NO / NC /Change Over	NO / NC/Change Over
e	Operating coil VA burden		
f	Making capacity of contacts		
g	Whether self reset type or hand reset type		
h	Draw out or non-drawout type		
i	Case finish		



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<b>29</b>	<b>DC Supply Monitoring Relay</b>		
a	Make		
b	Type and Model Name		
c	Aux Voltage (Volts)		
d	Number of normally contacts	N0 / NC/Change Over	N0 / NC/Change Over
e	Operating coil VA burden		
f	Making capacity of contacts		
g	Whether self reset type or hand reset type		
h	Draw out or non-drawout type		
i	Case finish		
<b>30</b>	<b>High Speed Tripping Relay</b>		
a	Make		
b	Type and Model Name		
c	Aux Voltage (Volts)		
d	Number of normally contacts	N0 / NC /Change Over	N0 / NC/Change Over



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e	Operating coil VA burden		
f	Whether High Impedance Type		
g	Whether self reset type or hand reset type		
h	Type of Flag indicator		
i	Operating Time		
j	Reset Time		
k	Draw out or non-drawout type		
l	Case finish		
<b>31</b>	<b>High Speed Inter Tripping Relay</b>		
a	Make		
b	Type and Model Name		
c	Aux Voltage (Volts)		
d	Number of normally contacts	NO / NC /Change Over	NO / NC/Change Over
e	Operating coil VA burden		
f	Whether High Impedance Type		
g	Whether self reset type or hand reset type		
h	Type of Flag indicator		
i	Operating Time		
j	Reset Time		



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k	Draw out or non-drawout type		
l	Case finish		
32	<b>ON/OFF switch for Spring charging motor</b> Make , Model & Rating		
33	<b>TTB for TOD meter</b> Make & Model No.		
34	Whether Removable HV Cable gland plate is provided with suitable cable entry holes		
35	Capacitive Voltage indicator for monitoring whether the Cable is Live or Dead Make/Model No.		
36	Cable Termination Height from gland plate level.		
37	Maximum Closing Time of Circuit Breaker (ms)		
38	Maximum Opening Time of Circuit Breaker (ms)		