SUPPLY CHAIN MANAGEMENT

THIRUVANANTHAPURAM

SPECIFICATION

Control & Relay Panels

APPLICABLE TO KSEBL	**Rev#0**	DOC. NO.: **SCM-SPEC/XT/ C&R Panel**
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Technical Specification and Evaluation Committee for Transmission Material

(i) Document Approval & Control Status

	Compiled by	Verified by	Approved by
Name	**Smt.Jayasree**	**Smt.Sajithakumari.T.S**	**Mr. Sanal Kumar.K**
Position	Assistant Executive Engineer (Supply Chain Management)	Executive Engineer (Supply Chain Management)	Chief Engineer (Supply Chain Management)
Date	27/04/2021	28/04/2021	03/05/2021
Signature	Sd/-	Sd/-	Sd/-

(ii) Amendments and History

Sec. #	*Rev. #*	*Date*	*History of Change*

1. Purpose:-

Purpose of this document is to document updates & history, upkeep and publish the specifications related to **Control & Relay Panels** 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 **Control & Relay Panels** 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**

Contents

TECHNICAL SPECIFICATION FOR CONTROL AND RELAY PANELS

1) SCOPE

1.1. The specification **provides requirement for** the design, documentation, engineering, manufacture, inspection and testing at suppliers works, packing and delivery at consignee address, unloading, supervision of commissioning and after sales support for Transformer and Feeder **Control & Relay Panels of various ratings along with supply of accessories necessary for operation,** to be installed at various sub stations of KSEBL. **Requirement is as per Schedule of Requirement (Part-I – Section E -D).**

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. The equipment manufactured should confirm to the relevant standards and of highest quality of engineering design and workmanship.

2.2. Unless otherwise specified all equipments and material shall generally conform to the latest IS/ IEC standards and shall comply with the following Standards as amended from time to time.

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 850/61850	Communication Networks and Systems in Sub Station
IEC 6100-4-29	DC Voltage dips and interruptions/ variations
IEC 60688	Transducers
IS 2705/ IEC 61869	Current Transformer
IS 3156/ IEC 61869	Voltage Transformer

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

2.4. 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.

2.5. 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	50^0C
Maximum ambient air temperature in shade	40^0C
Minimum ambient temperature in shade	17 ^{0}C
Maximum Relative humidity	100.00%
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

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 ^{0}C

4) SYSTEM PARTICULARS

Nominal System Voltage(kV)	220	110	66	33	11
Highest system Voltage (kV)	245	123	72.5	36	12
Number of phases	3				
Frequency	50 Hz ± 3%				
Neutral earthing	Solidly Earthed				
Auxiliary A.C. Supply	1-Phase,230 Volts, grounded with ±10% variation, Frequency 50Hz with ±3%				
Maximum Fault Current	40 kA (rms)				
Auxiliary D.C. Supply	110V DC. Voltage may vary from 90V to 150V during extreme operating conditions. The ripple content in DC supply from charger will be less than 5%. DC system is 2 (two) wire with necessary positive earth fault and negative earth fault annunciation scheme. DC supply shall be normally fed from Battery charger. In case of failure of AC supply to Battery Charger, DC supply voltage will be available				

	automatically from Lead Acid Battery.

5) PANEL DESCRIPTION, CONSTRUCTION AND FORMATION

5.1. GENERAL REQUIREMENT

a) Materials shall be new; the best quality of their respective kinds and such as are usual and suitable for work of like character. All materials shall comply with the latest issues of the specified standard unless otherwise specified or permitted by KSEBL.

b) Workmanship shall be of the highest class throughout to ensure reliable and vibrations free operations. The design, dimensions and materials of all parts shall be such that the stresses to which they may be subjected shall not cause distortion, undue wear, or damage under the most severe conditions encountered in service.

c) All parts shall conform to the dimensions shown and shall be built in accordance with approved drawings. All joints, datum surfaces and meeting components shall be machined and all castings shall be spot faced for nuts. All machined finishes shall be shown on the drawings. All screw, bolts, studs and nuts and threads for pipe shall conform to the latest standards of the International Organization for Standardization covering these components and shall all conform to the standards for metric sizes.

d) All materials and works that have cracks, flaws or other defects or inferior workmanship will be rejected by KSEBL.

5.2. CONSTRUCTIONAL FEATURES

a) For 110/33kV Transformer C&R panels, one simplex panel is to be provided on each side.

For 110/11kV ,66/11kV and 33/11kV Transformer C& R Panel one simplex panel is to be provided on HV Side only.

For 110kV,66kV and 33kV Feeder Control panel one simplex panel is to be provided.

For 220kV Feeder C&R panel one set of two simplex panels shall be provided with Main I relay in one panel and Main II Relay in second panel. Other components may be suitably distributed among two panels.

Proposed GA drawing/Scheme shall be attached with bid documents.

Height: 2200 mm + 100mm (with 15mm anti vibration pad)

Width: limited to 1000 mm (approximate Width of panels are given in Schedule of Equipments- Clause 32)

Depth: 800mm.

Earth bus extension slot : 60 X 30 mm

b) The Control and Relay Panel shall be of Simplex type and the access door shall be provided at the back of each Panel where no instruments or relays shall be mounted. The indicating and signaling devices and relays etc. shall be mounted on the front side and the auxiliaries which shall be inside the Panel. The access door shall be at the back side and of double door type (for panels with width less than 800mm single door is also acceptable) of height minimum 1900 mm having metal handle with built in flush type locking facility. A door stopper shall be provided with each door to hold it in open position.

c) In front of Panel where relays and instruments are to be mounted shall be stretcher leveled steel plate 3 mm. thick and side panel, doors and top covers shall be of 2mm. thick steel plate. Light sections of structural steel shall be used for panel frame.

d) Panel shall accommodate the equipment at a suitable height, suitable gaps to facilitate easy workability as specified hereafter. Individual piece of Channel base of C&R Panel is to be provided to obtain the flexibility of inter-changing the Panel, if any.

e) The complete panel shall incorporate all necessary instruments, meters, relays, auxiliary relays, control switches, indicating lamps, mimic, annunciator, audible alarms, horizontal and vertical wiring trough, wiring supports, interior lighting system, terminal blocks ,MCB, fuses and links etc.

f) The Control and Relay Panel frame shall be suitable for erection of flush concrete floor and secured to it by means of evenly spaced grout bolt projecting through the base channels from members of the frame. **The supplier shall provide necessary foundation drawings showing cable entry positions and foundation bolt location.**

g) The manufacturer shall ensure that the equipment specified and such unspecified complementary equipment required for completeness of protection/control scheme be properly accommodated in the panels without congestion and if necessary to provide panels with larger width. No price increase at a later date on this account shall be allowed.

h) Panels shall be completely metal enclosed and shall be dust, moisture and vermin proof for tropical use. The enclosure shall provide a degree of protection **not less than IP-51** in accordance with IS/IEC 60529. **Type test report in this respect shall be furnished with offer.**

i) Panels shall be free standing, floor mounting type and shall comprise structural frames enclosed completely with specially selected smooth finished, cold rolled sheet steel of thickness not less than 3 mm for weight bearing members of panels such as base frame, front sheets and door frames and not less than 2mm for sides, door, top & bottom portions. There shall be sufficient reinforcement /stiffners to

provide level surfaces, resistance to vibration and rigidity during transportation and installation. The panel shall be suitable to be rolled over rollers into installation position without distortion or damage. Minimum three hinges shall be provided for the doors.

j) Design, material selection and workmanship shall be such as to result in neat appearance, inside and outside with no welds, rivets or bolt head apparent front outside, with all exterior surfaces tune and smooth.

k) All doors, removable covers and panels shall be gasketed all around with **neoprene gaskets**. The gaskets shall be held in position mechanically and shall not be glued.

l) Ventilating covers, if provided shall have removable screens and filters to facilitate easy cleaning. Screens shall be made of either brass or Stainless Steel wire mesh**.**

m) All holes and extension windows in the Panel shall be blanked .

n) The manufacturer shall supply channel base, suitable grouting bolts, lock nut and washers.

o) Cable entries to the panel shall be from the bottom. Bottom plates of the panels shall be fitted with removable type separate cable entry plate (may be two) to allow cable entries from the bottom. Gland plates shall be suitable for fixing the cable glands at an **elevation of** at least 100 mm above the ground level. Cable glands shall be screwed type made of brass and shall be suitable for PVC armoured cable.

p) Terminal Connectors and Test terminal blocks for cables shall be fixed at an **elevation** of at least 200 mm above the Bottom plate.

q) Side blocks cut out to be arranged at the top of both sides of panel for inter panel bus wires. Dimensions of the cut out will be **300 mm X 50 mm** , 255 mm from the top. Cut outs shall be blanked properly .

r) A document holder shall be provided on door to keep manuals/ drawings.

5.3. ASSEMBLY:- Necessary items of equipment shall be assembled in the factory prior to shipment and routine tests shall be performed by the manufacturer as per the requirements of the latest issue of IEC/IS as specified under each equipment in these specifications to demonstrate to the satisfaction of **K S E B L** that the switchgear panels comply with the requirements of the relevant IEC/IS standards.

5.4. WELDING:- Wherever welding is specified or permitted, a welding process, including stress relieve treatment as required if necessary, conforming to an appropriate and widely recognized professional standard shall be used. All welders and welding operators shall be fully qualified by such a standard.

5.5. SUPPORTING STEEL:- The supplier shall supply all necessary embedded leveling steel, sills, anchor bolts, channels and other parts of supporting and fastening of the panel and vibration

damper. Embedded parts with detailed instructions shall be delivered in time to meet the schedule for insertion on the building structure.

5.6. OTHER ACCESSORIES:- Test link, special terminal boards and other accessories normally required for testing operations and maintenance of all relays meters shall be furnished by the supplier

6) 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.

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 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	60 to 80 microns
Special Instruction	A small quantity of finishing paint shall be supplied for minor touching up required at site after installation of the panels.

7) MOUNTING

a) All equipment on and inside the panels shall be mounted and completely wired to the terminal blocks ready for external connection.

b) All equipment on front panel shall be mounted flush, which ever possible.

c) Equipment shall be mounted such that removal and replacement can be accomplished individually without interruption of service to adjacent devices and are readily accessible

without use of special tools.

d) Terminal marking shall be clearly visible and of permanent nature.

e) The manufacturer shall carry out cutout, mounting and wiring of the bought out items which are to be mounted in the panel in accordance with the corresponding equipment manufacturer's drawings.

f) The centre lines of switches, push buttons and indicating lamps shall be matched to give a neat and uniform appearance. Likewise the top of all meters, relays and recorders etc. shall be in one line.

g) The centre line of switches, push buttons and indicating lamps shall be not less than 750 mm from the bottom of the panel. The centre line of relays and meters and recorders shall be not less than 450 mm from the bottom of the panel.

h) Switches, Meters, Relays especially Hand Reset Relays and other components shall be placed at convenient height to reset, read and operate without aid of additional tools or equipments, as the case may be.

i) The center lines of any relays, if additionally provided, shall not be less than 450 mm from ground level.

j) The control switches for circuit breakers shall be located on the mimic diagram corresponding to their exact position of the controlled equipment in the single line drawing. The location of the switches shall be within working height from the floor level for easy and comfortable operation.

k) All the equipment connections and cabling shall be designed and arranged to minimize the risk of fire and damage.

l) Cut outs provided for future mounting of equipment/ Interpanel wiring/ Earth Bus Bar extension/etc. shall be properly blanked off.

m) No equipment shall be mounted on the doors.

8) NAME PLATE AND IDENTIFICATION MARKINGS

a) All instruments, relays and such other similar electrical devices mounted on the control and relay panel shall be provided with name plates bearing the manufacturer's name, serial identifying number and the Electrical rating data.

b) 3mm thick and 25 mm wide brass or anodized aluminium plate bearing suitable identification marks shall be fixed under the terminal wiring at the test blocks, at the fuse blocks and at the cable terminals. Similar plates shall be fixed on the exterior of the panel in appropriate places to indicate function of control switches, push button etc. such as isolator control switch, breaker 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) 50mm wide black anodized aluminium plate bearing suitable circuit description (which will be furnished after order is placed) etched in 30 mm size letters shall be provided for each panel and mounted on the top of the front and back side of panels. These plates shall be removable type.

d) Schematic Diagram of CT, PT, CB circuitry & AC, DC Circuit, Indication and Annunciation Circuit along with protection circuitry giving the terminal nos. and Bus wire details shall be printed in laminated durable stickers and pasted inside the panel Door page wise of the respective panel.

e) Each unit of control and relay panel shall be provided with a Name Plate located at the bottom on the front and shall contain the following details :

i) Manufacturer's name

ii) P.O. No. and date

iii) Serial No./ Month & Year of Manufacture

iii) Drawing ref. no. pertaining to the panel.

iv) Guarantee Period:

f) 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.

g) Each Indicating instrument and meter shall be prominently marked with the quantity measured (ie. KV, A, MW).

9) 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, 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.

10) MIMIC DIAGRAM

a) Coloured mimic diagram and symbols showing the exact representation of the system

complete with symbols and colour strips to represent bus , feeders and semaphore indicators shall be provided in the front of control panels.

b) Mimic diagram shall be of **anodized aluminium** of approved fast colour material which shall be screwed on the panel and can be easily cleaned

c) Mimic shall be 10mm width for Bus and 7 mm for circuit.

d) The control switches shall be mounted along with mimic diagram.

e) Mimic height for No.1 bus shall be 1450mm and that of no.2 bus shall be 1400mm from the ground level.

f) Colour scheme for mimic diagram as follows:-

KV Class	Bus scheme	C o l o u r	Shade Index as per ISS
220 KV	**Double Bus**	Brilliant Green	221/IS-5
110kV	**Single/Double**	Signal Red	537/IS-5
66kV	**Single**	French Blue	166/IS-5
33kV	**Single**	Selmon Pink	443/IS-5
11kV	**Single**	Golden Yellow	356/IS-5
EARTHING		Black	

g) In C&R panels, Symbol marking for the position indication of isolators, earth switches etc, ON/OFF indication for Circuit breaker, PT supply indication, CB spring charge, auto trip, trip circuit healthy etc. shall be mounted along the mimic diagram at appropriate location.

11) Technical Particulars of PT & CT

a) Potential Transformers:-

For 33kV Feeder: & Transformer Control & Relay Panels

Rated primary voltage	33kV / √3
No. of secondary windings	2
Rated secondary voltage	110V /√3 for core I & II
Rated burden winding Core I /II/III	200VA/150VA
Accuracy class	
Winding I (Main I)	5P
Winding II (Metering)	0.2
System Neutral earthing	Effective neutral earthing

For 66 kV Feeder: & Transformer Control & Relay Panels

Rated primary voltage	66kV / √3
No. of secondary windings	2
Rated secondary voltage	110V /√3 for core I & II
Rated burden winding Core I /II/III	200VA/150VA
Accuracy class	
Winding I (Main I)	5P
Winding II (Metering)	0.2
System Neutral earthing	Effective neutral earthing

For 110 kV Feeder: & Transformer Control & Relay Panels

Rated primary voltage	110kV / √3
No. of secondary windings	3
Rated secondary voltage	110V /√3 for core I , II & III
Rated burden winding Core I /II/III	150VA
Accuracy class	
Winding I (Protection)	3P
Winding II (Metering)	0.2
Winding III (Protection)	3P

For 220 kV Transformer Control & Relay Panels

Rated primary voltage	220kV / √3
No. of secondary windings	3
Rated secondary voltage	110V /√3 for core I , II & III
Rated burden winding Core I /II/III	150VA
Accuracy class	
Winding I (Protection)	3P
Winding II (Metering)	0.2
Winding III (Protection)	3P

b) Current Transformers

For 33kV Feeder Control & Relay Panels

Rated voltage	33kV
Rated primary current	400-200A for Feeder 150-300 A for 33/11kV Trfr
Rated secondary current	1A
No. of cores	2
Rated output VA/Accuracy class	
Core 1 (metering)	60VA/0.2S
Core 2 (Main 1 Protection)	PS
Minimum knee point voltage	900V at 750 C
Maximum magnetizing current at KPV/2	50mA
Maximum secondary windings resistance at 750 C	< 5Ω
Ratio error & phase angle error	as per IS

66kV Feeder & Transformer Control & Relay Panels

Rated voltage	66 kV
Rated primary current	200-100 for 66/11kV Trfr 400-200 for 66kV Feeder
Rated secondary current	1A
No. of cores	4
Rated output VA/Accuracy class	
Core 1 Main 1 Protection	PS
Core 2 (Main II Protection)	PS
Core 3 (Metering)	60VA/0.2S
Core 4 (Back up protection)	5P
Minimum knee point voltage	900V at 750 C
Maximum magnetizing current at KPV/2	50mA
Maximum secondary windings resistance at 750 C	< 5Ω
Ratio error & phase angle error	as per IS

110kV Transformer Control & Relay Panels

Rated voltage	110 kV
Rated primary current	300-150-75 for 110/11kV Trfr 400-200-100 for 110/33kV Trfr 1200-600-300 for 220/110kV Trfr
Rated secondary current	1A
No. of cores	4
Rated output VA/Accuracy class	
Core 1 Main I Protection	PS
Core 2 (Main II Protection)	PS
Core 3 Metering	60VA/0.2S
Core 4 (Busbar Protection)	PS
Minimum knee point voltage	900V at 750 C
Maximum magnetizing current at KPV/2	50mA
Maximum secondary windings resistance at 750 C	< 5Ω
Ratio error & phase angle error	as per IS

220 kV Transformer Control & Relay Panels

Rated voltage	220 kV
Rated primary current	600-300 for 220/110kV Trfr **or** 400-200-100 for 220/33kV Trfr
Rated secondary current	1A
No. of cores	5
Rated output VA/Accuracy class	
Core 1 (Main 1 Protection)	PS
Core 2 (Main II Protection)	PS
Core 3 (Metering)	PS/ 0.2S 60VA/0.2S
Core 4 (Busbar Protection-Discriminating)	5P
Core 5 (Bus Bar Prot) Check zone	PS
Minimum knee point voltage	900V at 750 C
Maximum magnetizing current at KPV/2	50mA

Maximum secondary windings resistance at 750 C	< 5Ω
Ratio error & phase angle error	as per IS

* Exact Technical Details of PTs and CTs will be provided during drawing approval.

12) A.C. CIRCUITS

a) 230 Volts, Single Phase A.C. Aux. Supply to the Control and Relay Panel will be fed from A.C. Distribution Panel.

b) One 16 Amps rated double pole MCB shall be provided at the Control & Relay Panel for the Incoming A.C. Supply.

c) Teed off circuits shall be protected with MCBs of suitable rating.

d) A.C. operated no volt auxiliary relay (self reset type) rated for 230V shall be provided with hand reset flag with inscription – "A.C. FAIL" with 4NO+4NC contacts. 2 NC contact for AC fail alarm and indication, one for SCADA and one as spare wired to TB.

e) One push button having N/C contact used in series with above relay for A.C. Fail Test purpose.

13) DC CIRCUIT FOR C&R PANEL

a) Auxiliary DC supply shall be 110V DC. Each control & Relay panel shall be provided with necessary arrangements for receiving distribution, isolation and protection of 110V DC supply for various control, signaling, and protection circuits. All fuses shall be HRC cartridge type conforming to IS 2208 mounted on plug- in type fuse bases. All accessible line connection to fuse bases shall be adequately shrouded. Fuses shall have operation indicators for indicating blown fuse condition. Fuse carrier base shall have imprints of the fuse rating and voltage.

b) Annunciation DC shall be supervised by the Annunciator through auxiliary AC Supply of Annunciator in each panel. Suitable alarm contacts shall be wired to TB for indicating DC healthiness/ Failure to the SCADA system. One set of spare contacts shall be wired to TB (Redundant DC supply is mandatory for 220kV C&R panels only. For other C&R panels single DC supply is sufficient). The following clauses are applicable for redundant DC supply.

c) Main-1 and Main-2 protection and tripping circuits shall be independent and separate. The incoming DC and outgoing sub-circuits shall be separately provided with MCBs with auxiliary contacts that are extended for dc circuits supervision in each panel. Selection of the main and sub-circuits fuses ratings shall be such as to ensure selective clearance of sub-circuit faults.

d) The scheme to be designed to operate two group of protections on separate DC sources. Normally Main-1 Group of protections shall be connected to DC source-1 and Main-2 Group of protections shall be connected to DC source-2. BCU shall be automatically selectable from DC source 1 or 2. DC supply to protection relays, CB control and status monitoring, isolator control and status monitoring etc. shall be segregated into separate groups and shall be protected by MCBs. In the event of failure of one of the dc supply source if required the affected protection group can be changed over to the other DC source automatically/ manually using selector switches. Manual selector switch, if provided shall have 3 positions viz. DC-1/ DC-2/ Independent.

e) DC Supply 1& 2 , drawn to each panel shall be divided into the following sub circuits. Each sub circuit shall be controlled and monitored with the help of suitable MCB rated for DC, as applicable.

i) Circuitry of Main-1 Protection, CB Trip Coil-1 shall be fed from DC Supply-1

ii) Circuitry of Main-2 Protection CB Trip Coil-2 Shall be fed from DC Supply-2

14) EARTHING

a) All panels shall be equipped with an earth bus which run throughout the board fixed along with inside base of panels.

b) The tinned electrolytic grade copper flat earth bus bar shall be at least 50 x 6 mm unless specified otherwise.

c) When several panels are mounted adjoining each other, the earth bus shall be made continuous and necessary connectors and clamps for this purpose shall be included in the scope of supply.

d) Provision shall be made for extending the Earth Bus Bars to future adjoining panels on either side. Provision shall be made on the earth bus bars 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.

e) All current free metallic parts and metallic cases of equipment mounted in the switch board shall be done with independent soft drawn copper wires of size not less than 2.5 sq.mm.

f) The colour of earthing wires shall be **green with yellow line**.

g) Earthling wire shall be connected on terminals with suitable lugs/ clamp connections and soldering shall not be permitted.

h) 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

can be removed from one group without disturbing continuity of earthing system for other groups.

i) Earthing of equipments shall be individually terminated in Earth Bar.

j) Earthing pad of minimum size 30X30x6 mm shall be provided on the side of the panel.

k) Earthbus extension slot 60x30mm shall be provided on both sides of panel with suitable blanking plates.

15) PANEL WIRING

a) All wiring shall be carried out with **1100 volts** grade single core, multi strand flexible tinned copper wires with **FRLS** PVC insulation which is suitable for use in tropical region against hot and moist climate and vermin (Misc. white ant and cockroaches etc.)

b) Wire numberings and colour code for wiring shall be as per IS:5578/1984.

c) The wiring should be encased in suitable width PVC casing. Minimum 30% spare space should be provided in cable cases/troughs.

d) T he wiring diagram for various schematics shall be made on thick and laminated durable white paper in permanent black ink and same should be pasted on the inside surface of the door.

e) The sizes of wiring in different circuit shall not be less than these specified below:

Circuit	Permissible size of wire
Current Transformer Circuits for Metering and Relaying	4.0 mm²/**2.5 mm²**
Potential Transformer Circuits for Metering and Relaying, Auxiliary AC Supply Circuit, Auxiliary DC Supply Circuit, Earthing Circuit	2.5 mm²
Control, Visual Audible Alarms and Signaling Circuit	1.5 mm²

f) The following colour schemes shall be used for the Wiring:

Circuit where used	Colour of Wire
Red Phase of Instrument Transformer Circuits	Red
Yellow Phase of Instrument Transformer Circuits	Yellow
Blue Phase of Instrument Transformer Circuits	Blue
Neutral connection, earthed or not earthed in the instrument Transformer Circuit	Black

A.C. Control Wiring Circuits using auxiliary supply	Black
D.C. Control Wiring Circuit using Battery Supply	Grey
Earth Connection	Green with yellow

g) Ferrule markings shall be as follows (as applicable).

Main Protection	A11, A31, A51--
Bus bar Protection	B11, B31, B51 --
Backup protection	C11, C31, C51 - -
Metering circuit	D11, D31, D51 - -
PT Circuit	E11,E31,E51 - - -
AC Circuit	H1,H2,H3 - - - -
Main DC Circuit	J1, J2, J3 - - - -
DC Control Circuit	K1, K2, K3 - - - -
Indication Circuit	L1, L2,L3 - - - -
Motor Circuit	M1,M2,M3 - - - -
SCADA circuit	S1, S2, S3 - - - -
Spare Circuit	U1,U2,U3 - - - -
Wires directly connected to trip circuit breakers or device shall be distinguished by **additional red colored ferrule with marking "T".**	

h) All internal wiring shall be securely supported, neatly arranged, readily accessible and connected to equipment terminals and terminal blocks. Wiring gutters & trough shall be used for this purpose. The **rear side of all relays including auxiliary relays and other components shall be easily accessible from rear side for wiring checks. No wiring trough or other things shall block the accessibility from rear side.**

i) **Inter panel wiring** : Longitudinal troughs extending throughout the full length of the panel shall be used for inter panel wiring. Inter connections to adjacent panels shall be brought out to a separate set of terminal blocks wires. Auxiliary bus wirings for AC and DC supplies, voltage transformer circuits, annunciation circuits and other common service shall be provided near the top of the panels running throughout the entire length of the panel. These buses shall have a nominal cross section equivalent to a copper diameter of 6mm and shall be suitably insulated along their run. D.C. buses shall be divided into two sections to permit two independent supply points**.**

j) When panels are arranged to be located adjacent to each other all inter-panel wiring and connections between the panels shall be furnished and the wiring shall be carried out internally.

k) Entries for the inter panel wiring shall be properly carried out with proper ceiling for avoiding the accidental entry of any dust.

l) Wiring connected to the space heaters in the cubicles shall have porcelain beaded insulation over a safe length from the heater terminals.

m) Wire termination shall be made with solder less crimping type and non tinned copper lugs which firmly grip the conductor and insulation. Insulated sleeves shall be provided to all the wire terminations. **White PVC Tubular Ferrule with Black engraved core identification** marked to correspond with panel wiring diagram shall be fitted at both ends of each wire. Same marking shall be Ferrules shall fit tightly on the wire and shall not fall off when the wire is disconnected for any purpose. Termination shall be such that no strand of a conductor shall left loose or overhanging. Conductor termination shall be secured to the holding nuts/screws, terminal blocks etc. with washers interposed between the terminals/holding nuts/screw heads. The terminals shall be so connected that no conductor ferrule code gets masked due to overlay of conductors.

n) Wires directly connected to trip circuit breakers or device shall be distinguished by **additional red colored ferrule with marking "T".**

o) Numbers 6 and 9 shall not be included for the ferrules purpose.

p) All spare contacts of relays shall be wired up to terminal blocks.

q) Each wire shall be continuous from end to end and shall not have any joint within itself individually.

r) Wires shall be connected only at the connection terminals or studs of the terminal blocks, meters, relays, instruments and other panel devices.

s) Terminal Ends of all wires shall be provided with numbered Ferrules. At point of inter-connection where a change of number is necessary, duplicate Ferrules shall be provided with the appropriate numbers on the changing end.

t) At the terminal connection, washers shall be interposed between terminals, wire terminals and the holding nuts. All holding nuts shall be secured by locking nuts. The connection stud shall project at least 6 mm from the lock nut surface. Wire ends shall be so connected at the terminal studs that no wire terminal numbered ferrule gets masked due to succeeding connections. All wires shall be suitable for bending to meet the terminal stud at right angles with the stud axis, and they shall not be skewed.

u) All studs, nuts, bolts, screws, etc shall be threaded according to the British Standard practice unless KSEBL's approval to any other practice of threading is obtained.

v) External cables shall be terminated to only one side (Either Left or Right in a particular Terminal Block) of all terminal blocks. Factory wiring and field wiring shall not be mixed in the same cable tray.

w) Signalling Cable shall be shielded type and bundled separately. CT and PT wiring shall also be bundled separately.

16) TERMINAL BLOCKS

a) All internal wiring to be connected to the external equipment shall terminate on terminal blocks, preferably vertically mounted on the side of each panel. Terminal blocks shall be 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.

b) Terminal blocks shall be of clip-on design made out of non - trackable insulating material of **1100 V grade**. All terminals shall be stud type, with all current carrying and live parts made of tinned plated brass. The studs shall be of min 4 mm dia brass. The washers, nuts, etc. used for terminal connectors shall also be of tinned plated brass. All blocks shall be shrouded by easily removable shrouds made of transparent die-electric material

c) Terminal blocks for Current Transformer and Voltage Transformer secondary leads shall be provided with test links and isolating facilities. The terminal connector/blocks shall be disconnecting type terminal connectors for PT. The terminal connector/blocks of C.T. secondary leads shall be provided with short circuiting and earthing facilities of adequate rating. All other terminal connectors shall be Non-disconnecting type.

d) Terminal should be shock protected in single moulded piece. Terminal block should have screw locking design to prevent loosening of conductor.

e) Provision shall be made on each pillar, for holding 10% extra connection (5% incoming + 5% outgoing).

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

g) All terminals shall be provided with ferrules indelibly marked or numbered and identification shall correspond to the designations on the relevant wiring diagrams. . Markings on the terminal strip shall correspond to wire number and terminal numbers on the wiring diagram

h) The terminals shall be rated **1100 V** grade for adequate capacity which shall not be less than 10 Amps continuous rating for control circuit. For power circuit it shall not be less than 15 Amps.

i) Not more than 2 wires shall be connected to any terminal. Suitable supports shall be provided for the incoming cable.

j) There shall be minimum clearance of 250 mm between the first row of terminal blocks and the associated cable gland plate. Also, the clearance between two rows of terminal blocks shall be minimum of 150mm. . The terminal blocks shall be arranged to provide maximum accessibility to all conductor terminations.

k) Arrangement of the terminal block assemblies and the wiring channels within the enclosure shall be such that a row of terminal blocks is run parallel and in close proximity along each side of the wiring duct to provide for convenient attachment of internal panel wiring.

l) The side of the terminal block opposite the wiring duct shall be reserved for the purchaser's external cable connection and cable trough should be provided for this. Adjacent terminal blocks shall share this field wiring trough.

m) The panel shall be wired internally from all the equipment to the terminal box ready for the Board's external cable connections at the terminal blocks. All spare contacts of the equipments / devices shall also be wired to the terminal blocks for Board's external use.

n) Terminal box accommodating terminations at voltages of 110V and above shall be partitioned off and the voltage clearly labeled. 415/230V circuit terminals shall be fitted with non inflammable transparent plastic covers to prevent contact with any live parts. Warning labels with red lettering shall be mounted thereon in a conspicuous position. Terminal block associated with external source of supply shall be fully shrouded and fitted with danger warning labels. If a common termination is required between termination blocks, preformed jumpers or manufacturers own shorting device shall be used. Terminal blocks shall be grouped according to functions i.e.Power supplies (AC or DC), PT, CT, DC Controls, Annunciation, SOE, SCADA, etc. and shall be labeled accordingly. Terminal blocks for different voltages (AC or DC) , CT and PT etc shall be located in separated DIN Rails.

o) Terminal blocks shall be assembled on side panel mounted DIN Rails and shall be arranged in one tier. AS far as possible DIN rail shall be mounted vertical.

p) The design shall be such that the accumulation of dust and moisture is minimized, but the creepage distance between poles or to ground shall be at least 8mm. The insulating material should be poly amide and all the metal parts shall be non ferrous.

q) Terminal block design shall include white fibre marking strip with clear plastic, slip on/clip on terminal covers. 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.

17) SEMAPHORE INDICATOR

a) Automatic semaphore indicators shall be provided for automatic indication in the mimic diagram of position (open or close) of circuit breakers (63mm dia), isolators and earthing switches (48mmdia).

b) They shall be of two coil type and their operating voltage shall be station DC supply (110V DC).

c) They shall also have the supply failure indication during which the disc comes to neutral position when both units of indicators shall be so mounted on the mimic diagram that the close position shall complete the continuity of the mimic.

d) Their strips shall be of the same colour as of the associated mimic.

18) CONTROL AND SELECTOR SWITCHES

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.

f) Switch function, requirement and marking details shall be as given below.

Switch Function	**Requirement**	**Operating Position marking in Escutcheon plate**
Breaker Control	Spring return to neutral with lost motion device, Pistol grip handle, lockable, Three position Trip – Neutral –Close (Handle or base of breaker Control switch shall have Red Colour)	Trip – Neutral – Close
Isolator Control	Spring return to neutral with lost motion device, Pistol grip handle, Three position	Open– Neutral – Close

	Open– Neutral –Close	
DC Selection	Stay put, Pistol grip black , Three position (Source 1- independent-Source 2) for Main I and Main 2	Source 1 independent-Source 2
Auto reclose Selection	Stay put, Pistol grip black , Four position (OFF-1PH-3PH-1&3pH)	OFF-1PH-3PH-1&3pH
Carrier Source selector	Stay put, Pistol grip black , Two position (IN/OUT)	IN/OUT
SCADA Selector	Stay put, Pistol grip black , Two position (LOCAL/SCADA)	LOCAL/SCADA
Synchronisation Selector	Stay put, Pistol grip black , Three position, lockable (Dead Line/Live Line/ Bypass)	Dead Line/Live Line/ Bypass

g) Sufficient No. of ways for control switch shall be provided based on protection scheme and other requirements.

h) Adequate number of spare contacts shall be provided on breaker control switch for control interlocking, annunciation and disrupt indication and shall be wired up to Terminal Block.

19) INDICATING LAMPS

a) L.E.D. Type Indicating Lamps shall be provided on the Control Panel to indicate the following:

Sl.No.	Functions	Colour of Lamp
1	C.B. Spring charged indication	Blue
2	C.B. trip Coil/Circuit healthy indication	White
3	C.B. Auto tripped indication	Amber
4	Panel D.C. Fail indication	Amber
5	P.T. Supply indicating Lamp	Red/Yellow/Blue
6	C.B. —ON indication	Red
7	C.B. —OFF indication	Green
8	Isolator close	Red
9	Isolator open	Green
10	For miscellaneous Indications	Yellow

b) All the lamps shall be connected to the auxiliary D.C. supply of the Sub-Station except

Sl. No. (4) & Sl. No. (5) which should be connected to the auxiliary A.C. supply and P.T. Secondary supply respectively.

c) LEDs shall be of miniature switchboard type, suitable for panel mounting with rear terminal connections and shall be Low Watt consumption. All indicators shall have bright LEDs having long life.

d) Conventional incandascent bulbs are not acceptable.

e) The indicating LEDs assembly shall withstand 120% of rated voltage on a continuous basis.

f) LEDs should be sufficiently bright enough so as to be visible even in well illuminated area even at lowest range of auxiliary supply.

g) Lamps for circuit breaker "ON", "OFF", "TRIP CKT HEALTHY" and "AUTO TRIP" indications LED indicating lamp complete with static circuits and features should be supplied with Low voltage protection circuit (LVGP) and surge suppressor circuit having LED indication.

h) Lamp assembly should be of fire – retardant glass epoxy PCB , industrial heat resistant, fire resistant, non hygroscopic DMC material, chrome – plated corrosion resistant solid brass bezel, polycarbonate lens in desired colour shades of Red, Green , Amber, Yellow, White, etc.

i) The intensity of light should be minimum 100 mcd at 20 mA.

j) Indication lamp should be suitable to operate on 110 V direct current supply source.

k) No tools shall be required for replacing the bulbs and lenses. These lamp cover shall be of screwed type, unbreakable and moulded from heat resisting material. Integral Engraved plates shall be provided

20) 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.

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

21) SPACE HEATERS

a) 240 V, 50 HZ Tubular Space Heaters suitable for connection to the Single Phase A.C.

Supply complete with On-Off Switches located at convenient position shall be provided at the bottom of the Panel to prevent condensation of moisture.

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) The 240 V AC supply for the heater shall be controlled by a suitably rated single pole miniature circuit breaker compartment to be mounted on an insulator.

f) Wiring connected to space heaters in the cubicle shall have porcelain beaded insulation over a safe length from heater terminals.

22) Interior Lighting and Receptacles

a) The Panel interior shall be illuminated by **9/10/12W** 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 each Panel for A.C. Supply.

23) MCBs, Switches,Fuses and Links

a) Each control 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 with auxiliary contacts that are extended for trip indication in each panel.

c) Selection of the main and sub-circuits fuses 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. **All MCBs shall be provided with Auxiliary Contact for monitoring status.**

e) Metering PT MCB shall be provided before TTB.

24) Test Blocks

a) 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.

b) 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.

c) A 3 phase 4 wire Link type TTB with back connection for Energy meter and shall be placed near to the meter.

d) All terminals, shorting links and screws shall be of brass and nickel plated to prevent corrosion.

e) All meters (A,MW,MVAR) shall be connected after TTB for testing their accuracies along with Energy meter calibration.

f) Relay Test Block (with test plug) shall be provided adjacent to the Relay to it's Right Hand Side and **shall have facility to short the CT connections internall**y, upon plugging without using any shorting wires externally .

g) For IEDs DC Auxiliary supply shall not be routed through test blocks.

h) There shall be adequate spare terminals.

i) Test block shall be suitable to insert Banana plugs for making external connections. No other types are acceptable.

j) If one test block is not sufficient, two test blocks shall be provided to accommodate all CT/VT/DC wiring as per requirements and specifications.

k) Test block shall be provided for each functional device, if used with CT and VT secondary wiring and on the RHS of the device.

l) All protective relays fed with CT/VT, Measuring Numerical devices fed with CT/VT etc shall be provided with test blocks.

m) All Trip and LBB initiation signals are to be routed through Test blocks including Inter-trips.

n) On Insertion of the Test plug, the relay shall go to the Test mode to avoid any unwanted tripping. In the case of more than one Test block , insertion of any one Test plug shall make relay go to the test mode.

o) Suitable isolation facility shall be provided on the input wire connection from Test block to the relay and isolation of this wire shall make relay come out of Test mode even in Test block inserted condition.

p) TTB for metering circuit should have CT & PT circuits, Relay Test Blocks shall be separate for Main I and Main II which include CT, PT, DC and Trip Circuits. Only approved makes shall be permitted to use.

25) ANNUNCIATOR

25.1. Annunciator System:- Alarm annunciation system shall be provided for the Control and Relay 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.

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

25.1.1. 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.

25.1.2. 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.

25.1.3. 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.

25.1.4 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
iv) Reset Push Button Pressed	Close	ON	OFF
	Open	OFF	OFF
v) Lamp test Push button is pressed	Open	Steady ON	OFF

25.2. 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 control 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 facia 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 facia LED will glow.

i) Annunciator facia units shall be suitable for flush mounting on panels. Replacement of individual facia 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 control 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 conditions do not appear due to influence of external magnetic fields on the annunciator wiring and switching disturbances from the neighbouring 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.

26) Instruments, Meters and Recorders

26.1. **DIGITAL MULTI FUNCTION METERS:-** Each panel shall be provided with a Digital Multi-function meter suitable for operation inbalanced as well as unbalanced load, Four quadrant metering.

Auxiliary Power Supply	:	110V DC
Connection Type	:	3 phase, 4 wire
PT/CT primary	:	Configurable at site
Voltage Input	:	110V 3ph, N
Current Input	:	1A AC
Frequency	:	50 Hz
Accuracy Class	:	0.2S
Display Unit	:	Multi line multi-digit Backlit LCD/ LED with 4-Quadrant Identification
Displayed Parameters (min)	:	V (LL & LN), I (L1, L2, L3, N), F, MW, MVA, MVAr, THD (V &I)
Default Display parameters	:	Configurable
Communication	:	RS485 MODBUS RTU & Ethernet port for connecting to SAS/ SCADA

26.2. ENERGY METERS

a) TOD type Bidirectional 3 phase 4 wire CT/PT operated Tri vector meters with the following specifications should be provided.

Aux Power Supply	:	Self powered from VT supply input
Connection type	:	3 phase 4 wire
Voltage input	:	110V,3ph,N
Current Input	:	1A AC
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. on Aux. supply
Display	:	kW,kWh,kVah,kVarh,MD,I,V,pf,&Hz shall be available by scrolling.
Communication	:	RS 485 MODBUS RTUC(Energy meters in 220kV Panels shall also have ethernet DLMS ports.

b) There can be 1, 2, or 3 modes of display, which facilitate more parameters. More accurate reading on power etc up to 6 decimal place shall be provided in the mode 3. Retains the last recorded reading even under power failure. Default setting for any parameter – say kwh- shall be given. Meter shall be bi-directional and shall display import & export. Shall have data retrieval & logging facility, Load Survey Feature, etc. Necessary software with license (One set for every 10 Panels) for feeding settings, commissioning, testing, extracting the data/ readings etc and required inter facing cables/ devices shall be supplied with each meter.

c) Accuracy class : 0.2S

d) The energy meter shall be connected to the secondary of Potential Transformers and Current Transformers (rated for 1 A) respectively. Meters shall be compensated for temperature errors and factory calibrated to directly read the primary quantities without the use of the additional multiplying factor. Multiplying factor, if unavoidable shall be multiple for 10 and shall be subject to purchaser's prior approval. Number of digits provided, shall be adequate to cover at least 1000 hrs. of operations.

e) The current coil of the meters shall have a continuous over load capacity of 200% for both accuracy and thermal limits. Also the current coils shall withstand at least 10 times the rated current for 0.5 second without loss of accuracy. The meters shall have retransmitting contacts, the impulse rate of which shall be suitable for remote indicating or summating system.

f) The meter shall be provided with RS 485 serial port with MODBUS RTU Protocol for communication purposes with data logging system. The data transfer rate shall 9600 bauds or better.

g) The meter shall be **DLMS compliant**. The details of MODBUS addresses like MODBUS register address in map/ MODBUS point map register list, etc shall be submitted along with the engineering submittals.

h) The meter shall have load survey features. It should be capable of recording load survey data on real time –Phase wise voltages, Phase wise currents, Active Energy, Apparent Energy, Active Power, Reactive Power, Power factor, for period of 60 days for 15/ 30

minutes integral period.

i) Feature of locking data at midnight of last day of each month shall be included.

27) Transducers

a) **Programmable** Multi function transducer (3 phase-4 wire, 110VDC Aux) shall be provided and wired up to terminal blocks exclusively for SCADA connectivity to measure and convert parameters of three-Phase 3⁄4 wire AC power network with balanced or unbalanced system. Transducer shall have RS 485 bus interface (MODBUS) and RS232 serial interface for programming, accessing and executing functions.

b) The transducer shall have four Analog outputs of 4-20mA.

c) Transducers (for use with Indicating Instruments and Telemetry/Data Communication application) shall in general conform to IEC:60688-1.

d) The input to the transducers will be from sub-station current & potential transformers.

e) The output shall be in milli ampere D.C. proportional to the input & it shall be possible to feed the output current directly to the telemetry terminal or indicating instruments.

f) The transducer characteristic shall be linear throughout the measuring range.

g) The transducer output shall be load independent.

h) The input & output of the transducer shall be galvanically isolated.

i) Transducer shall be housed in a compact case and have suitable terminals for inputs & outputs.

j) The transducers shall be suitably protected against transient high peaks of voltage & current.

k) The transducer shall withstand indefinitely without damage and work satisfactorily at 120% of the rated voltage and 120% of the rated input current as applicable.

l) The response time of the transducers shall be minimum 1s.

m) The accuracy class of transducers shall be 0.2.

n) Any extra items like software, interface cable for programming /operation, if required, shall be supplied free of cost for each transducer.

28) SCADA REQUIREMENTS

1) Time coded signals of trip/Alarm of each protection used, Master Trip, AC Failure, Trip Circuit Failure, SF6 gas pressure, driving mechanism trouble, VT failure, DC failure, etc. are to be separately wired /grouped and kept ready for future use wired up to Terminal Blocks specifically marked as “SCADA”.

2) CT, VT secondary circuit routing must be restricted up to C&R Panels only. SCADA requirements shall be taken from Multi Function Transducers installed in the control panel meant for that application as per Cl.27.

29) Protection Scheme

29.1. **33kV feeder panel** shall be provided with Numerical three phase over current and earth fault relays as main protection.

29.2. **66 KV & 110kV** feeder C&R Panel shall be provided with Numerical Distance relay as Main protection and Numerical directional three phase over current and earth fault relay as Back up protection. Main scheme- Distance Relay, Numerical type (Non-switched numerical relay to be fed either from line VTs or bus VTs)

29.3. **220kV feeder C&R Panel** shall be provided with two Numerical Distance relays (IED) of **different make & model** as Main I and Main II protection. Each IED should be operated from two independent DC sources with appropriate DC selection scheme. Main scheme- Distance Relay, Numerical type (Non-switched numerical relay to be fed either from line VTs or bus VTs)**.** The scheme shall be devised in such a way that the protection trip is extended to the circuit breaker even when ANY ONE element in the scheme fails.

29.4. **33/11KV Transformer C&R panel** shall be provided with numerical high impedance REF relay as Main protection and Numerical three phase over current and earth fault relay as back up protection

29.5. **66/11 KV Transformer C&R Panel** shall be provided with Numerical Differential relay and Electro mechanical REF relay as Main protections and Numerical three phase over current and earth fault relay as backup protection.

29.6. **220/110KV, 110/33 KV &110/11 KVTransformer C& R Panels** shall be provided with two numbers Numerical Differential Relays inbuilt low impedance REF protection suitable for transformers . The relays shall be of different make or same make with different Model no. as Main I and Main II protection. Each IED should be operated from two independent DC sources with appropriate DC selection scheme. There should be provision for 2 numbers of 3 phase current inputs, 1 number of 3 phase VT input and 1 number of neutral CT current input. The scheme shall be devised in such a way that the protection trip is extended to the circuit breaker even when ANY ONE element in the scheme fails. Transformer monitoring Relays shall be provided on LV panel.

30) PROTECTION RELAYS

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 & vermin proof.

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 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 hand reset positive action operation indicators provided with inscription subject to purchaser's approval. Timers shall be of the electromagnetic or solid-state type.

11) No control relay that shall 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. Current and voltage relays in all protections with time delayed operation shall have reset ratio between 0.85 and 1.20.

13) Auxiliary seal-in-units provided on the protective relays shall preferably be of shunt reinforcement type. If series relays are used the following shall be strictly ensured.

All necessary provision for easy testing of relays

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. As per I.E.C., the relays must withstand 5KV; 1x150 micro second 0.5 joule source energy impulses test or 1.5 MH_Z 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.

16) All relays shall be designed for operating under an ambient temperature of 50^0 C and 100% relative humidity. Electronic type timers shall be avoided as far as possible.

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.

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 however not be acceptable.

22) The solid state relays shall be stable and suitably protected against transient/ induced over voltage.

23) The built in features provided in the numerical relays should be in enabled condition.

24) Approved Relays are listed below. The Model numbers mentioned for IEDs are indicative only. If a specified model does not meet the specification, higher end model shall be used.

Relay Function → Make ↓	Relay Model No.					
	FEEDER (Distance)	**FEEDER (Distance)**	**TRANSFORMER (Differential)**	**TRANSFORMER (Differential)**	**O/C& E/F**	**REF**
	220kV	**110kV,66kV**	**220/110kV**	**110/33,110/11,66/11**		
ALSTOM	P443	P443	P645	P643	P145	CAG14
GE	D60	D30	T60	Multilin 845	Multilin 650	
SEL	SEL 421	SEL 321/311C	SEL 487E	SEL 787/487E	SEL 351	
ABB	REL 670 (Ver 2.0 or higher)	REL 650	RET 670	RET 650	REF 615	
SIEMENS	7SA522	7SA86/7SA522	7UT85	7UT85	7SJ85	
SCHNEIDER	P443	P443	P645	P643	P145	
TOSHIBA		GRZ100		GRT100		

* Siemens 7SR-1 Series is not acceptable.

30.1 Auxiliary Relays

a) D.C. Voltage operated auxiliary relays provided with mechanically operated hand reset indicator and sufficient no. of hand reset contacts shall be provided for protection and supervision against faults. No of elements and number of relays shall be as per requirement of the protection scheme.

b) Self reset auxiliary monitoring voltage relays for specified DC voltage shall be provided for use in the interlocking scheme for multiplication of contacts, and for monitoring of control supplies and circuit. Monitoring relays or lockout relay circuit shall be connected in series with lockout relay coils. The supplier shall be responsible to ensure that the monitoring relay rating are such that they shall positively pick up through the breaker

coils/lockout relay coil monitored, but breakers / lockout relays shall not operate with such a connection.

c) The supply and circuit-monitoring relay shall be connected to initiate an alarm upon failure of respective supply circuit. They shall preferably have reverse flag, which drop when the relay is de-energized. Otherwise, an indicating lamp shall be provided with each monitoring relay for indication of its operation.

30.2. Trip Circuit Supervison Relays

a) Panels should be provided with D.C. Voltage operated Trip Circuit Supervision Relay having provisions for pre & post close supervision of Trip Circuit with set of self-reset contacts provided for Trip Circuit Healthy Indication and Trip Circuit unhealthy indication & Alarm in respect of Trip Coil/circuits of respective Breakers .

b) ~~The~~ Each trip circuit shall be supervised by dedicated trip circuit supervision relays. This scheme shall continuously monitor all the six trip circuits(two per phase) & two trip circuits for gang operated CB's in 110kV,66kV and 33kV before closing and after closing of the breaker. This scheme shall detect (1) Failure of trip supply (2) open circuit of trip circuits wiring and (3) failure of mechanism to complete the tripping operation.

c) The relay shall have a delay in drop off at least 200ms to avoid a false alarm during a normal tripping operation.

d) The relays shall have necessary contacts to be connected to either the alarm bell or to the annunciator available in the control panel for visual and audible indication of the failure of trip circuit.

30 .3. DC Supply Supervision:- DC supply supervision scheme shall be provided in each panel as part of the annunciator through a separate system of DC No voltage relay. In the event of failure of DC supply to annunciator, a potential free contact shall be made available to operate a bell energized by ac supply. The alarm should be acknowledged through the alarm acknowledge push button of the respective panel.

30.4. High speed Tripping Relay

The relay shall be of

1. High burden
2. Be instantaneous (operating time not to exceed 10ms.)
3. Shall be draw out type
4. Hand Reset with flag for operation as lock out relay;
   Self reset for operation as auxiliary trip relay
5. Be DC operated.

6. Have adequate contacts to meet the requirement of scheme, other functions like auto-reclose relay, LBB relay , event logger, disturbance recorder, fault Locator, remote annunciation, SCADA signal, etc.
7. Be provided with operation indicator for each element/coil.
8. 2 pairs potential free NO+NC contacts as spares shall be wired to Terminal Block for future use.

30.5. TRIP CIRCUIT/COIL SUPERVISION SCHEME

Trip circuit supervision scheme shall be such that testing of trip circuit healthiness is possible irrespective of whether the C. B. is in the closed or open position. Pre Close and Post Close Close supervision is essential. The Trip Circuit Healthy LED should glow on demand in C.B. ON , OFF position. The rating of dropping resistance in series with Trip Circuit Healthy LED shall be such that the Trip Coil should not get damaged because of continuous current flowing through it.

30.6. NUMERICAL RELAYS /(IEDs)

a) All IEDs shall be IEC 61850 Edition 2 compliant.

b) Parallel Redundant FO Ports shall be provided for relays used for 110kV & 220kV

c) All IEDs should have sufficient numbers of binary inputs and out puts as required by the scheme.

d) General requirement of IEDs

Nominal Current (In): 1A

Thermal rating: 3xIn continous

70xIn for 1 sec

Nominal Voltage: 110V

240V continuous

Frequency : 50Hz

Aux supply: 110V DC

e) Digital Inputs and Outputs

Number of inputs and outputs may be selected so that after implementing protection scheme specified, at least 6 number inputs and 6 number outputs are freely available for the purchaser for future use.

30.6.1. Numerical Distance Relay(For 110 KV & 66kV Feeder panels):-The relay shall be modular in construction. The protection algorithm shall use the fault voltages and currents as well as the superimposed voltages and currents to arrive at a secure trip decision in the shortest possible

time. The scheme shall provide protection against all types of faults on OH lines viz. line-to-line, line to earth and multi-phase without switching.

The characteristics shall be **selectable (Quad or Mho)** with independently adjustable reactive and resistive reach for line-to-line and line to earth.

There shall be minimum of three forward zones and a reverse zone. The zone reach setting ranges shall be sufficient to cover the line length appropriate to each zone.

Following features shall be available as standard and wired as required.

Protection functions

1) Non-switched distance protection (21,21N)
2) Carrier aided scheme options such as permissive under reach, over reach, zone 1 extension and blocking.(85)
3) Secured directional response under all conditions (achieved by memory voltage polarization or healthy phase voltage polarization as appropriate)
4) VT fuse failure detection scheme and appropriate precautions in measurement to avoid a mal operation.
5) Appropriate logic to take care of Switch on To Fault condition(SOTF).
6) Power swing blocking feature with facilities for fast detection of power swing, selective blocking of zones, selective unblocking criteria for earth faults, phase faults and three phase faults.(68)
7) Selection of single pole or three pole or both tripping schemes.
8) Fault locator with an accuracy of at least 3%.
9) Independent Earth Fault protection to take care of highly resistive faults. (50N,51N,67N) .
10) Independent phase over current protection (50,51,67)
11) Breaker failure protection (50BF)
12) Synchro-check (25)
13) Auto re close functions with facilities for three pole tripping(79)
14) Over and under voltage protection (59,27)
15) Over/under frequency protection (81O,80U)
16) Trip circuit supervision (74TC)
17) Disturbance Recorder: Shall record analog and digital channels with programmable trigger. Minimum sampling frequency shall be 1000Hz. Minimum

duration of recording shall be 2.5sec. The relay shall store at least 10 of such time stamped Disturbance Records in non volatile memory.

18) Event logging: The relay shall have event logging function capable of storing a minimum of 500 time stamped events in non volatile memory.

19) Display of voltage, current and power on demand

20) Self-diagnostic features.

21) Communication interface.:

Front interface(USB/RJ45) for connecting PC

Rear optical ethernet port with IEC 61850 Edition2 compliant. Rear port shall dual redundant.

Time synchronization – SNTP ,PTP & IRIG-B

22) Digital Inputs and Outputs Shall have sufficient isolated programmable digital inputs (minimum 16 nos) and digital output (minimum 21 nos) . Number of inputs and outputs may be selected so that after implementing protection scheme specified at least 6 number inputs and 6 number outputs are freely available for the purchaser for future use.

23) Have self diagnostic feature and watch dog output

24) The relay shall have a comprehensive local HMI interface so that the relay can be accessed and setting changes can be done locally.

25) Flexible control of all input and output contacts shall be provided.

26) The contact of the relay shall have the following minimum rating

Make and carry continuously	: 5A DC
Make and carry for minimum 1 sec	: 30A DC ,
Breaking capacity for DC when L/R is 40m sec	: 30W

27) The following minimum latched indication shall be available with facility for resetting.

Type of fault - phases involved.

Zone of fault.

Trip received through carrier.

Switch on to fault.

PT fuse failure.

Power swing blocking condition.

28) Spare LEDs configurable shall be available.

29) Parallel line mutual compensation feature shall be provided.

The relay testing & commissioning software shall be provided in CD also for subsequent installation if needed. Any up gradation to the software shall be of free of cost. The software shall have graphic capabilities for display and suitable interface to generate user defined reports in addition to the standard report forms. The interfacing cable for communicating with the relay may be supplied along with relay testing and communication software.

30.6.2. 220kV FEEDER protection numerical DISTANCE relays Main I and Main II.

a) Relays shall be IEC 61850 compliant IEDs

b) The Main I and Main II IEDs shall be of different make or same make with different Model

c) Thermal rating : 4xIn continous, 100xIn for 1 sec

d) The relay shall be modular in construction. The protection algorithm shall use the fault voltages and currents as well as the superimposed voltages and currents to arrive at a secure trip decision in the shortest possible time. The scheme shall provide protection against all types of faults on OH lines viz. line-to-line, line to earth and multi-phase without switching.

e) The characteristics shall be polygonal with independently adjustable reactive and resistive reach. They shall have mho and quad characteristics for phase to phase fault and phase to earth fault.

f) There shall be minimum of three forward zones and a reverse zone. The zone reach setting ranges shall be sufficient to cover the line length appropriate to each zone.

g) Both Main I and Main II IEDs shall have following features available as standard and wired as required.

h) Protection functions

1) Non-switched distance protection (21,21N).
2) Carrier aided scheme options such as permissive under reach, over reach, zone 1 extension and blocking.(85)
3) Secured directional response under all conditions (achieved by memory voltage polarization or healthy phase voltage polarization as appropriate)
4) PT fuse failure detection scheme and appropriate precautions in measurement to avoid a mal operation.
5) Appropriate logic to take care of Switch on To Fault condition (SOTF).

6) Power swing blocking feature with facilities for fast detection of power swing, selective blocking of zones, selective unblocking criteria for earth faults, phase faults and three phase faults.(68).

7) Selection of single pole or three pole or both tripping schemes.

8) Fault locator with an accuracy of at least 3%.

9) Independent Earth Fault protection to take care of highly resistive faults. (50N,51N,67N) . The relay shall have built–in directional as well as non-directional Earth fault features with minimum two stages for selecting either stage one or two or both. During the failure of PT Supply, the non-directional element has to be automatically enabled.

10) Independent phase over current protection (50,51,67).

11) Breaker failure protection (50BF).

12) Synchro-check (25)

13) Auto reclose functions with facilities for single as well as three pole reclosing(79). Under normal conditions, A/R of Main 1 only will be active. When Main 1 is unhealthy or in test mode, A/R of Main 2 Shall be active.There shall also be provision for reclosing under evolving fault condition.

14) Over and under voltage protection (59,27).

15) Over/under frequency protection (81O,80U).

16) Disturbance Recorder: Shall record analog and digital channels with programmable trigger. Pre fault and post fault duration shall be settable. Minimum sampling frequency shall be 1000Hz. Minimum duration of recording shall be 2.5 sec. The relay shall store at least 100 of such time stamped Disturbance Records in non volatile memory.

17) Event logging: The relay shall have event logging function capable of storing a minimum of 500 time stamped events in non volatile memory.

18) Display of voltage, current and power on demand.

19) Self-diagnostic features and watch dog output.

20) Broken conductor detection feature.

21) Communication interface:-

Front interface(USB/RJ45) for connecting PC

Rear optical ethernet port compliant **with IEC 61850 edition 2**

IRIG-B port for Time synchronization

22) Digital Inputs and Outputs: Have sufficient isolated programmable digital input (minimum 24nos.) and digital output (minimum 24nos.) for implementing protection scheme specified. Number of inputs and outputs may be selected so that after implementing protection scheme specified at least 6 number inputs and 6 number outputs are freely available for the purchaser for future use.

23) The relay shall have a comprehensive local HMI interface so that the relay can be accessed and setting changes can be done locally.

24) Sufficient LED indications (programmable) shall be there on the front panel for quick reading of major relay indications.

25) Flexible control of all input and output contacts shall be provided.

26) The contact of the relay shall have the following minimum rating.

Make and carry continuously : 5A DC

Make and carry for minimum 1 sec : 30A DC ,

Breaking capacity for DC when L/R is 40m sec: 30W

Sufficient number of output contacts shall be rated for directly operating Trip Coil.

27) The following minimum latched indication shall be available with facility for resetting.

Type of fault - phases involved.

Zone of fault.

Trip received through carrier.

Switch on to fault.

PT fuse failure.

Power swing blocking condition.

28) Spare LEDs configurable shall be available.

29) **Bay control unit for 220kV feeder panels:-** These specifications cover important parameters only. The tenderers are required to furnish the details not specially mentioned herein but relevant to the context, also if any.

Power Supply :

Nominal Voltage	:	110 VDC
Range	:	77-150V DC
Frequency	:	50 ± 5 Hz

The relay shall withstand a 100% interruption in the auxiliary DC supply without de-energizing for minimum 50ms

Analog AC Voltage Inputs

Nominal Voltage (Vn)	:	110 V AC rms, 50 Hz (Ph-Ph)
Continuous Voltage	:	2 x Vn

Analog AC Current Inputs

Nominal Current (In)	:	1 A, 50 Hz
Continuous	:	4 x In
Short Time Current Rating	:	100 x In for 1s

Binary Outputs:- The BCU shall have programmable Binary Outputs suitable for tripping, signaling and annunciation having the following:

Number of Binary outputs : Sufficient number of Binary Inputs shall be provided to cater the requirements as per the approved scheme including 20% spare BO's wired up to terminal blocks. Minimum 6 numbers of BO with capability to trip CB directly shall be provided.

Rated voltage	:	110V DC
Make & Carry continuously	:	5A
Make & Carry short time	:	30A (0.2 s)
DC break capacity	:	50W resistive, 25W Inductive (L/R 40ms)

Binary Inputs:- Have Opto-Isolated Binary Inputs with the following requirements:

Number of inputs : Sufficient number of Binary Inputs shall be provided to cater the requirements as per the approved scheme including 10% spare BI's

Nominal voltage	:	110V DC
Minimum BI Threshold	:	77 V DC

Bay Control Unit functions:

Self-monitoring facility

Electrical SLD views showing status of all electrical devices in the Bay Shall have Synchronism Check and Dead source functions (DL-DB, LL-DB, DL-LB, CS) Integral metering functions to display Current, Voltage, Frequency Power components etc. Method of determining zero sequence voltage shall be derived internally into the relay. All controller IEDs (BCUs) shall have synchro phasor measuring elements conforming to IEEE 37.118.1

Programmable scheme logic

Shall have Single phase pole tripping function

Auto reclose (in case of OH Line feeder BCU)

The BCU shall include three-pole and single-pole auto re-closer function. The auto re-closer shall allow applying different dead-times for single-line-to-ground and multi-phase faults.

The relay shall have Synchro-check and Dead Line charging schemes

Disturbance Recorder & Fault Locator

The BCU shall provide oscillographic disturbance recording capability and Sequence of Events (SOE) function with high time stamping accuracy.

Disturbance recorder: Shall record analogue and digital channels with programmable trigger. The sampling frequency of analog inputs shall be at least 1000 Hz. The relay shall store multiple disturbance records with duration adjustable from 100ms to at least 1.8 secs, and shall capacity to store records at least 10 seconds total duration in non-volatile memory. The pre-fault and post-fault record time shall be adjustable.

Event Logging: The relay shall have event logging function capable of storing a minimum of 500 time stamped events with 1 ms resolution in non-volatile memory.

Fault Locator: Have built in fault locator with facility to display the fault location either in percentage of line length or in actual distance in kilometer based on reactance setting. FL shall be possible to be enabled even if distance function is disabled

Communication & Local Interface

Have USB/RJ45 Front port for local interfacing with laptop

Have Dual Rear optical ports conforming to IEC 61850 Edition-2 PRP for communication & future SAS integration.

The BCU shall have a comprehensive local HMI interface with LED display and Input Keypad so that

the IED can be accessed and setting changes can be done locally.

The BCU shall be provided with minimum 15 numbers of programmable LEDs with latching options.

Other Features

Time synchronization: IRIG-B & SNTP/PTP interface shall be provided for GPS time synchronisation

Metering: Have metering function of accuracy 2% or better with display of various metering parameters

Necessary latest version of Software should be supplied for Configuration &, setting of the relay.

Full version software shall be provided Disturbance Record & Oscillogram viewing and analysis etc.

The IED settings shall be provided with 2 level password protection

30.6.3. Numerical Differential Relay for 110/33 kV and 110/11kV Transformer C& R Panels:- The relay shall be modular in construction. Following features shall be available as standard and wired as required.

Protection functions:-

1) The relay shall be flush mounting type.

2) Enclosure protection shall be as per standards.

3) Protection against magnetizing inrush current proof, fifth, fourth harmonic restraint/ bypass feature and also be stable under normal over fluxing conditions.

4) Have facility for vector group compensation, CT ratio and phase compensation. **Shall be suitable for two winding Transformer as well as Auto transformers up to 40 MVA capacity and voltage up to 110 KV.**

5) The relays shall have facility for cross block in harmonic restraining

The functions required in each IEDs are given below.

Percentage Biased differential protection:-

with dual slope; slope 1 range:10-50%; slope 2 range: 50-90%

break point 1: 0-2pu; break point 2 : 1-10pu

pick up :settable from 0.1pu to 0.5pu;

shall be suitable for 3 phase two winding and auto transformers

shall provide magnitude and phase angle and vector group compensation

shall be inrush current proof and harmonic restrained

provision for zero sequence filtering

should have instantaneous high set differential element

operating time : within 30ms

Restricted Earth fault protection:-

suitable for auto transformer

shall be low impedence biased type;

slope settable from 20-80%

pick up from 10-40%

operating time: within 30 ms;

Over current and E/F

The relay shall incorporate two nos. of 3 phase current inputs that can be independently enabled for over current protection

The over current element per group shall provide phase over current and earth fault protection with IDMT standard inverse Characteristics.(for HV and LV side)

Over flux

The relay shall provide volts/hertz protection

Thermal over load

The relay shall provide thermal overload element

Circuit Breaker Failure

The relay shall provide CBF protection for two beakers(for HV and LV side)

The elements should be current supervised

Operating time settable at 200ms.

The following functions shall be available in the relay with full scheme

1) Transformer differential protection with dual slope
2) Circuitry fault alarm
3) 3.Restricted earth fault protection for HV and LV windings
4) Through fault monitoring
5) Non directional over current
6) Negative phase sequence over current
7) 7.Thermal overload
8) Non directional E/F element
9) Volts/Hz
10) Under/Over voltage
11) Under/ Over frequency
12) Circuit Breaker Fail(CBF)for HV and LV windings
13) Trip circuit supervision

Also the relay shall have the following features

1) Programmable logic

2) Measurements and recording facilities

i) **Disturbance Recording:-**

Should provide disturbance recorder with all the measured

analog channels and calculated analog values such as differential and bias currents;

should also record digital information such as trips,

configured inputs and out puts;

should be capable of recording at rate of 20 samples/cycle (minimum) of 2.5 s

should be able to hold minimum of 10 records in non volatile memory; Minimum sampling frequency shall be 1000Hz.

ii) Event logging: The relay shall have event logging function capable of storing a minimum of 500 time stamped events in non volatile memory. Time synchronisation with IRIG B port

iii) Display of voltage, current and power on demand

iv) Self-diagnostic features.

v) Communication interface:- Compliant to IEC 61850 Edition 2**: T**here should be minimum 2 optical rear Ethernet ports with Parallel Redundancy.

Front interface(USB/RJ45) for connecting PC

Time synchronization via SNTP , PTP,NTP and IRIGB

vi) Digital Inputs and Outputs

Have self diagnostic feature and watch dog output

Have programmable 12 nos. input (minimum) 16 nos. output (minimum). Number of inputs and outputs may be selected so that after implementing protection scheme specified at least 6 number inputs and 6 number outputs are freely available for the purchaser for future use.

The relay shall have a comprehensive local HMI interface so that the relay can be accessed and setting changes can be done locally.

Flexible control of all input and output contacts shall be provided.

The contact of the relay shall have the following minimum rating

Make and carry continuously : 5A DC

Make and carry for minimum 1 sec : 30A DC ,

Breaking capacity for DC when L/R is 40m sec: 30W

The following minimum latched indication shall be available with facility for resetting.

Type of fault - phases involved.

The relay testing & commissioning software shall be provided in CD also for subsequent installation if needed. Any up gradation to the software shall be of free of cost. The software shall have graphic capabilities for display and suitable interface to generate user defined reports in addition to the standard report forms. The interfacing cable for communicating with the relay may be supplied along with relay testing and communication software.

30.6.4. Numerical Differential Relay for 220/110kV Transformer C& R Panel:- The functions required in each IEDs are given below.

Percentage Biased differential protection

with duel slope; slope 1 range:10-50%; slope 2 range: 50-90%

break point 1: 0-2pu; break point 2 : 1-10pu

pick up :settable from 0.1pu to 0.5pu;

shall be suitable for 3 phase two winding and auto transformers

shall provide magnitude and phase angle and vector group compensation

shall be inrush current proof and harmonic restrained

provision for zero sequence filtering

should have instantaneous high set differential element

operating time : within 30ms

Restricted Earth fault protection

suitable for auto transformer

shall be low impedence biased type;

slope settable from 20-80%

pick up from 10-40%

operating time: within 30 ms;

Over current and E/F

The relay shall incorporate two nos. of 3 phase current inputs that can be independently enabled for over current protection

The over current element per group shall provide phase over current and earth fault protection with IDMT standard inverse Characteristics.(for HV and LV side)

Over flux

The relay shall provide volts/hertz protection

Thermal over load

The relay shall provide thermal overload element

Circuit Breaker Failure

The relay shall provide CBF protection for two beakers(for HV and LV side)

The elements should be current supervised

Operating time settable at 200ms.

Disturbance Recording

Should provide disturbance recorder with all the measured

analog channels and calculated analog values such as

differential and bias currents;

should also record digital information such as trips,

configured inputs and out puts;

should be capable of recording at rate of 20 samples/cycle (minimum) of 2.5 s

should be able to hold minimum of 10 records in non

volatile memory;

Event Logging

Should be able to record minimum 1000 time stamped events

Time synchronisation with IRIG B port

Compliant to IEC 61850: There should be minimum **2 optical rear Ethernet ports (with parallel port redundancy)**

Binary input/output

Digital Inputs and Outputs Shall have sufficient isolated programmable digital inputs (minimum 16 nos) and digital output (minimum 21 nos) . Number of inputs and outputs may be selected so that after implementing protection scheme specified at least 6 number inputs and 6 number outputs are freely available for the purchaser for future use.

30.6.5. Back-up over-current and earth fault protection (For 66/11kV,33/11 KV transformer panels, 66kV & 33kV Feeder panels):- The relay shall be of numerical type . Following features shall be available as standard and wired as required.

1) Earth Fault protection . (50N,51N).
2) Three Phase over current protection (50,51,67).
3) CBF protection.
4) Event logging: The relay shall have event logging function capable of storing a minimum of 500 time stamped events in non volatile memory.
5) Display of voltage, current and power on demand.
6) Self-diagnostic features.
7) Communication interface:-

   Front interface(USB/RJ45) for connecting PC

   Rear optical ethernet port with IEC 61850

   Time synchronization via SNTP
8) Digital Inputs and Outputs

   Have self diagnostic feature and watch dog output Have prograrimable 12 nos. input (minimum) 12 nos. output (minimum) and are field programmable.

   The relay shall have a comprehensive local HMI interface so that the relay can be accessed and setting changes can be done locally.

   Flexible control of all input and output contacts shall be provided.

   The contact of therelay shall have the following minimum rating

   Make and carry continuously : 5A

   Make and carry for minimum 1 sec : 30A ,

   Breaking capacity for DC when L/R is 40m sec: 30W

The relay testing & commissioning software shall be provided in CD also for subsequent installation if needed. Any up gradation to the software shall be of free of cost. The software shall have graphic capabilities for display and suitable interface to generate user defined reports in addition to the standard report forms. The interfacing cable for communicating with the relay may be supplied along with relay testing and communication software.

30.6.6. REF protection (For 66/11KV 33/11 KV Transformer C&R panel):

Shall be Electromechanical Type

Current rating	:1A
Setting range	: 10 to 40%
Relay contacts	: 2 N/O contacts suitable for operation at 110V DC
Make and carry	: 5A

Operating time : Less than 30ms

Operating flag : Hand Reset

Shall have harmonic stability

Burden : Less than 2VA

31) TESTS

31.1 Type Test:-

a) The Manufacturer should submit the Type test report including **IP test of Control and Relay Panels and functional test** for all the protective relays carried out within **five years** 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 failing which the lot shall be rejected.

b) For Relays following type test report is to be submitted

1) Insulation tests as per IEC 60255-5
2) DC Voltage dips and interruptions/Variation as per IEC 61000-4-29.
3) High frequency disturbance test as per IEC 61000-4 16, Class IV (Not applicable for electromechanical relays)
4) Electrostatic discharges as per IEC 61000-4-2, level; 4 (not applicable for Electromechanical relays)
5) Fast transient test as per IEC 61000-4-4, Level I**V** (Not applicable for electromechanical relays)
6) Relay characteristics, performance and accuracy test as per IEC 60255
7) Steady state Characteristics and operating time
8) Dynamic Characteristics and operating time for distance protection relays.
9) Conformance test as per IEC 61850-10. For numerical relays.
10) Tests for thermal and mechanical requirements as per IEC 60255-6
11) Contact performance test as per IEC 60255-0-20

31.2 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 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 relays, meters & annunciators provided in the control & relay 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 :-** The following Tests shall be carried out 6 copies of Test certificates shall be Submitted for approval.

1) Checking of wiring of circuits and the continuity.

2) One minute applied voltage test. All Equipment on panel and small wiring shall be tested for withstand voltage of 2000Volts to earth & between different voltage circuits.

3) Insulation resistance of the complete wiring, circuit by circuit with all equipments mounted on the Board before and after H.V. test mentioned under 2 above.

4) Routine tests according to relevant National standard are on the Instruments, relays & other devices.

5) Test procedures shall be forwarded along with inspection call.

6) **The Equipments shall only be dispatched after approval of the test certificates and issue of Material Despatch Cum Clearance (MDCC) from KSEBL**

32) SCHEDULE OF EQUIPMENTS

Only recommended makes of Relays and Energy Meters are acceptable. For other items, makes other than recommended ones are subject to approval of purchasing authority during

drawing approval.

32.1.1. 33KV FEEDER CONTROL & RELAY PANEL (Single Bus Arrangement)

Sl. No.	Item Description	Qty	Recommended Make *
1	Simplex Panel with Base frame (WXDXH) 800X800X 2300 mm	1 nos.	Superior make
2	Mimic Diagram	1 set	Superior make
3	Name Plate for Panel Designation Equipment Identification and Device labels (Inside and Out side)	1 set	Superior make
4	Semaphore indicators for Circuit Breaker 63mm Dia	1 No	DAV /Superior
5	Semaphore indicators for isolators 48mm	2 no.	DAV /Superior
6	Semaphore indicators for earth switch 48mm	1 no.	DAV /Superior
7	Control switch for circuit breaker : three position spring return to neutral position with lost motion device with locking arrangements.	1 no.	KAYCEE/RECOM/SWITRON
8	Switch for DC selection (Source 1-off-Source 2) Three position stay put	1 no.	KAYCEE/RECOM/SWITRON
9	Switch for LOCAL/ SCADA selection: two position, stay put	1No.	KAYCEE/RECOM/SWITRON
10	Indicating lamps (LED)with red (ON), green (OFF)and amber (AUTO TRIP) coloured lense for circuit breakers	3No.	DAV/TEKNIC/ESSEN
11	Indicating lamps (LED)with white lense for Trip Circuit Healthy 1&2	2 nos.	DAV/TEKNIC/ESSEN
12	Push Button for Alarm Accept and Trip Circuit Healthy 1 &2 Test	3 Nos.	DAV/TEKNIC/ESSEN
13	Annunciator system: 16 window	1 set	ALAN/ BHARANI

	facia with built in push buttons for Accept, Reset and LampTest with warning annunciation- Hooter (for Trip), Bell (for Non-Trip), Buzzer (for DC Fail),etc		
14	Ammeter 144x144mm: Analog Accuracy 1 or better	3Nos.	AE/MECO/IMP/RISHAB
15	Voltmeter 72x144mm: Digital to show R_Y,Y_B,B_R voltages Accuracy 1 or better	3 Nos.	AE/MECO/IMP/RISHAB
16	MW Meter 144x144mm : Analog, Accuracy 1 or better	1No.	AE/MECO/IMP/RISHAB
17	MVAR Meter 144x144mm : Analog, Accuracy 1 or better	1No.	AE/MECO/IMP/RISHAB
18	Energy meter Accuracy 0.2S	1No.	L&T/SECURE
19	Numerical Directional Three Over Current and One Earthfault Relay	1 No.	ABB/ALSTOM/SIEMENS/GE/SCHNEIDER/SEL/
20	Master Trip Relay with Hand Reset	1No.	ABB/ALSTOM/ SIEMENS
21	Trip Circuit supervision relays	1 set	ABB/ALSTOM/ SIEMENS
22	DC Supervision Relay	1 set	ABB/ALSTOM/ SIEMENS
23	Auxiliary Relays for Trip and Close Circuit	1 set	ABB/ALSTOM/ SIEMENS
24	Test Block for Energy meter	1 no.	AE/MECO/DAV
25	Test Blocks and Test Plugs for O/C+E/F Relay	1 no.	ABB/ALSTOM/
26	Multifunction Transducer Accuracy 0.2	1 No.	Rishabh/AE/MECO
27	Led Interior Lighting with door switch	1 set	Philips/ Havells/ Superior make
28	Multipin universal socket 15A with switch	1 set	Anchor/ Superior make

29	MCBs with auxiliary contact	As required	BUSSMAN/ SCHNEIDER/ SUPERIOR
30	Space Heater with Thermostat and control switch	1 set	Girish/Superior
31	Cable Gland	As Required	Superior make
32	Terminal Block 1100V Grade	As Required + 20% spares	Elmex/Connectwell
33	Tinned Copper Earth Bar 50x6mm	As Required	Superior make
34	Wires for connections/ earthing 1100V Grade, FRLS,ISI marked	As Required	Superior make
35	All other auxiliary relays, AC no volt relay with test Pushbutton, timers, contact multiplication, accessories ,etc required for proper functioning of protection and control scheme.		
36	Items required for erection of panels including achor bolt, channels, levelling steel sills, antivibration pads, earth bar extension		
37	Test links, special terminal boards, other accessories required for testing, maintenance and operation.		

32.1.2. Sample Annunciator Facia Inscription for 33kV Feeder C&R Panel:- (Annunciator shall have 16 window facia to give following target Indications and shall be wired accordingly)

Sl.No.	Inscription
1	Over Current protection Operated
2	Earth Fault Protection Operated
3	CB SF6 Low
4	CB Spring Discharged
5	PT Fuse Fail
6	Breaker Lockout.

7	Control DC Fail.
8	O/C+ E/F Relay Faulty
9	AC Fail
10	MCB Trip
11	Ann. DC Fail
12	Spare
13	Spare
14	Spare
15	Spare
16	Spare

32.2.1. 66KV FEEDER CONTROL & RELAY PANEL (Single Bus Arrangement):-

Sl. No.	Item Description	Qty	Recommended Make *
1	Simplex Panel with Base frame (WXDXH) 800X800X 2300 mm	1 nos.	Superior make
2	Mimic Diagram	1 set	Superior make
3	Name Plate for Panel Designation Equipment Identification and Device labels (Inside and Out side)	1 set	Superior make
4	Semaphore indicators for Circuit Breaker 63mm Dia	1 No.	DAV /Superior
5	Semaphore indicators for isolators 48mm	3 no.	DAV /Superior
6	Semaphore indicators for earth switch 48mm	1 no.	DAV /Superior
7	Control switch for circuit breaker : three position spring return to neutral position with lost motion	1 no.	KAYCEE/RECOM/SWITRON

	device with locking arrangements.		
8	Switch for DC selection (Source 1-off-Source 2) Three position stay put	1 no.	KAYCEE/RECOM/SWITRON
9	Switch for LOCAL/ SCADA selection: two position, stay put	1No.	KAYCEE/RECOM/SWITRON
10	Indicating lamps (LED)with red (ON), green (OFF)and amber (AUTO TRIP) coloured lense for circuit breakers	3No.	DAV/TEKNIC/ESSEN
11	Indicating lamps (LED)with white lense for Trip Circuit Healthy 1&2	2 nos.	DAV/TEKNIC/ESSEN
12	Push Button for Alarm Accept and Trip Circuit Healthy 1 &2 Test	3 Nos.	DAV/TEKNIC/ESSEN
13	Annunciator system: 16 window facia with built in push buttons for Accept, Reset and LampTest with warning annunciation- Hooter (for Trip), Bell (for Non-Trip), Buzzer (for DC Fail),etc	1 set	ALAN/ BHARANI
14	Ammeter 144x144mm: Analog Accuracy 1 or better	3Nos.	AE/MECO/IMP/RISHAB
15	Voltmeter 72x144mm: Digital to show R_Y,Y_B,B_R voltages Accuracy 1 or better	3 Nos.	AE/MECO/IMP/RISHAB
16	MW Meter 144x144mm : Analog, Accuracy 1 or better	1No.	AE/MECO/IMP/RISHAB
17	MVAR Meter 144x144mm : Analog, Accuracy 1 or better	1No.	AE/MECO/IMP/RISHAB
18	Energy meter Accuracy 0.2S	1No.	L&T/SECURE
19	Numerical Directional Three Over Current and One Earthfault Relay	1 No.	ABB/ALSTOM/SIEMENS /GE/SCHNEIDER/SEL
20	Numerical distance relay	2Nos	ABB/ALSTOM/SIEMENS/

			GE/SCHNEIDER/SEL/
21	Master Trip Relay with Hand Reset	1No.	ABB/ALSTOM/ SIEMENS
22	Trip Circuit supervision relays	1 set	ABB/ALSTOM/ SIEMENS
23	DC Supervision Relay	1 set	ABB/ALSTOM/ SIEMENS
24	Auxiliary Relays for Trip and Close Circuit	1 set	ABB/ALSTOM/ SIEMENS
25	Test Block for Energy meter	1 no.	AE/MECO/DAV
26	Test Blocks and Test Plugs for O/C+E/F Relay	1 no.	ABB/ALSTOM/Siemens
27	Multifunction Transducer Accuracy 0.2	1 No.	Rishabh/AE/MECO
28	Led Interior Lighting with door switch	1 set	Philips/ Havells/ Superior make
29	Multipin universal socket 15A with switch	1 set	Anchor/ Superior make
30	MCBs with auxiliary contact	As required	BUSSMAN/ SCHNEIDER/ SUPERIOR
31	Space Heater with Thermostat and control switch	1 set	Girish/Superior
32	Cable Gland	As Required	Superior make
33	Terminal Block 1100V Grade	As Required + 20% spares	Elmex/Connectwell
34	Tinned Copper Earth Bar 50x6mm	As Required	Superior make
35	Wires for connections/ earthing 1100V Grade, FRLS,ISI marked	As Required	Superior make
36	All other auxiliary relays, AC no volt relay with test Pushbutton, timers, contact multiplication, accessories ,etc required for proper functioning of protection and control scheme.		
37	Items required for erection of panels including achor bolt, channels, levelling steel		

	sills, antivibration pads, earth bar extension
38	Test links, special terminal boards, other accessories required for testing, maintenance and operation.

32.2.2. Sample Annunciator Facia Inscription for 66kV Feeder C&R Panel:- (Annunciator shall have 16 window facia to give following target Indications and shall be wired accordingly)

No.	**Inscription**
1	Over Current protection Operated
2	Earth Fault Protection Operated
3	Distance Protection operated
4	CB SF6 Low
5	CB Spring Discharged
6	PT Fuse Fail
7	Breaker Lockout.
8	Control DC Fail.
9	O/C+ E/F Relay Faulty
10	AC Fail
11	MCB Trip
12	Ann. DC Fail
13	Distance relay faulty
14	LBB Operated
15	SOTF operated
16	Breaker reclosed
17	Spares

32.3.2. 66/11kV Transformer Control & Relay Panel (HV Side only):-

Sl. No.	Item Description	Qty	Recommended Make *
1	Simplex Panel with Base frame(WXDXH) 900X800X 2300 mm	1 nos.	Superior make
2	Mimic Diagram	1 set	Superior make
3	Name Plate for Panel Designation Equipment Identification and Device labels (Inside and Out side)	1 set	Superior make
4	Semaphore indicators for Circuit Breaker 63mm Dia	1 No.	DAV/ Superior Make
5	Semaphore indicators for isolators 48mm	2 no.	DAV/ Superior Make
7	Control switch for circuit breaker : three position spring return to neutral position with lost motion device with locking arrangements.	1 no.	KAYCEE/RECOM/SWITRON
8	Switch for DC selection (Source 1-off-Source 2) Three position stay put	1 no.	KAYCEE/RECOM/SWITRON
9	Switch for LOCAL/ SCADA selection: two position, stay put	1No.	KAYCEE/RECOM/SWITRON
10	Indicating lamps (LED)with red (ON), green (OFF)and amber (AUTO TRIP) coloured lense for circuit breakers	3No.	TEKNIC/ Superior make

11	Indicating lamps (LED)with white lense for Trip Circuit Healthy 1&2	2 nos.	TEKNIC/ Superior make
	Indicating lamps (LED)with red (ON) and green (OFF) coloured lense for Isolators	4 nos.	TEKNIC/ Superior make
12	Push Button for Alarm Accept and Trip Circuit Healthy 1 &2 Test	3 Nos.	TEKNIC/ Superior make
13	Annunciator system: 24 window facia with built in push button for Accept, Reset and LampTest with warning annunciation- Hooter (for Trip), Bell (for Non-Trip), Buzzer (for DC Fail),etc	1 set	ALAN/ BHARANI
14	Ammeter 144x144mm: Analog Accuracy 1 or better	3Nos.	AE/MECO/Superior make
15	Voltmeter 72x144mm: Digital to show R_Y,Y_B,B_R voltages Accuracy 1 or better	3 Nos.	AE/MECO/Superior make
19	MW Meter 144x144mm: Analog Accuracy 1 or better	1No.	AE/MECO/Superior make
21	MVAR Meter 144x144mm : Analog, Accuracy 1 or better	1No.	AE/MECO/Superior make
22	Energy meter, Accuracy 0.2S	1No.	L&T/SECURE
23	Numerical Directional Three Over Current and One Earthfault Relay	1 No.	ABB/ALSTOM/SIEMENS/ GE/SCHNEIDER/SEL
24	Numerical Differential Relay	1 No.	ABB/ALSTOM/GE/SIEMENS/

			SCHNEIDER/SEL/TOSHIBA
25	REF Relay with variable stabilising resistor	1 No.	CAG14
27	Master Trip Relay with Hand electrical Reset	1No.	ABB/ALSTOM/GE/SIEMENS/ SCHNEIDER/SEL
28	Trip Circuit supervision relays	1 set	ABB/ALSTOM/GE/SIEMENS/ SCHNEIDER/SEL
29	DC Supervision Relay	1 set	ABB/ALSTOM/GE/SIEMENS/ SCHNEIDER/SEL
30	PT Voltage Selection Relay	1 set	ABB/ALSTOM//GE/SCHNEIDER/SIEMENS /SEL
31	Auxiliary Relays for Trip and Close Circuit	1 set	ABB/ALSTOM//GE/SCHNEIDER/SIEMENS SEL
32	Auxiliary Relays for Transformer Supervision	12 Nos.	ABB/ALSTOM//GE/SCHNEIDER/SEL/ SIEMENS
33	Auxiliary Relay for REF	As required	ABB/ALSTOM/GE/SCHNEIDER/SEL/ SIEMENS
34	Test Block for Energy meter	1 no.	Superior make
35	Test Blocks and Test Plugs for O/C+E/F Relay	1 no.	Superior make
36	Test Blocks and Test Plugs for Numerical Differential Relay	1 no.	Superior make
37	Multifunction Transducer Accuracy 0.2	1 No.	Rishabh/AE/MECO
38	Led Interior Lighting with door	1 set	Philips/ Havells/ Superior make

	switch		
39	Multipin universal socket 15A with switch	1 set	Anchor/ Superior make
40	MCB with auxiliary contacts	As required	Superior make
41	Space Heater with Thermostat and control switch	1 set	Superior make
42	Cable Gland	As Required	Superior make
43	Terminal Block 1100V Grade	As Required + 20% spares	Elmex/Connectwell
44	Tinned Copper Earth Bar 50x6mm	As Required	Superior make
45	Wires for connections/ earthing 1100V Grade, FRLS,ISI marked	As Required	Superior make
46	All other auxiliary relays, AC no volt relay with test Push button, timers, contact multiplication, accessories ,etc required for proper functioning of protection, intertrip and control scheme.		
47	Items required for erection of panels including anchor bolt, channels, levelling steel sills, antivibration pads, earth bar extension		
48	Test links, special terminal boards, other accessories required for testing, maintenance and operation.		

32.3.2. Sample Annunciator Facia Inscription for 66/11 kV Transformer C&R Panel (HV Side Only) - (Annunciator shall have 24 window facia to give following target Indications and shall be wired accordingly

Sl. No.	Inscription
1	DIFFERENTIAL PROTECTION TRIP
2	REF TRIP

3	OC /EF PROTECTION OPERATED
4	CB LOCKOUT
5	TRANSFORMER INTER TRIP
6	TRIP CIRCUIT FAIL
7	BUCHOLZ TRIP
8	OLTC BUCHOLZ TRIP
9	WTI TRIP
10	OIL TEMP TRIP
11	PRV TRIP
12	CB SF6 LOW
13	RELAY FAULTY
12	AC FAIL
15	CONTROL DC FAIL
16	ANN. DC FAIL
17	LOW OIL ALARM
18	BUCHOLZ ALARM
19	WTI ALARM
20	OIL TEMP ALARM
21	MCB TRIP
22	SPARE

23	SPARE
24	SPARE

32.4.1. 110 KV FEEDER CONTROL & RELAY PANEL (Double Bus Arrangement)

Sl. No.	Item Description	Qty	Recommended Make *
1	Simplex Panel with Base frame(WXDXH) 900X800X 2300 mm	1 nos.	Superior make
2	Mimic Diagram	1 set	Superior make
3	Name Plate for Panel Designation Equipment Identification and Device labels (Inside and Out side)	1 set	Superior make
4	Semaphore indicators for Circuit Breaker 63mm Dia	1 No.	DAV/ Superior Make
5	Semaphore indicators for isolators	3 no.	DAV/ Superior Make
6	Semaphore indicators for isolators 48mm	1 no.	DAV/ Superior Make
7	Control switch for circuit breaker : three position spring return to neutral position with lost motion device with locking arrangements.	1 no.	KAYCEE/RECOM/SWITRON
8	Switch for DC selection (Source 1-off-Source 2) Three position stay put	2 no.	KAYCEE/RECOM/SWITRON
9	Switch for LOCAL/ SCADA selection: two position, stay put	1No.	KAYCEE/RECOM/SWITRON
10	Carrier Service Selector Switch, Two position, stay put	1No.	KAYCEE/RECOM/SWITRON
11	Auto Reclosing Selector Switch Two position, stay put	1No	KAYCEE/RECOM/SWITRON
	Synchro Selector Switch Two position, stay put	1No	KAYCEE/RECOM/SWITRON

12	Indicating lamps (LED)with red (ON), green (OFF)and amber (AUTO TRIP) coloured lense for circuit breakers	3No.	DAV/TEKNIC/ESSEN
13	Indicating lamps (LED)with Yellow lense for Trip Circuit Fail 1&2	2 nos.	DAV/TEKNIC/ESSEN
14	Indicating lamps (LED)with Amber lense for DC FAIL	1 Nos	DAV/TEKNIC/ESSEN
15	Push Button for Trip Reset	1	DAV/TEKNIC/ESSEN
16	Push Button for DC Fail Accept	1	DAV/TEKNIC/ESSEN
17	Annunciator system: 24 window facia with built in push button for Accept, Reset and LampTest with warning annunciation- Hooter (for Trip), Bell (for Non-Trip), Buzzer (for DC Fail),etc	1 set	ALAN/ BHARANI
18	Ammeter 144x144mm: Analog Accuracy 1 or better	3Nos.	AE/MECO/IMP/RISHAB
19	Voltmeter 72x144mm: Digital to show R_Y,Y_B,B_R voltages Accuracy 1 or better	3 Nos.	AE/MECO/IMP/RISHAB
20	MW Meter 144x144mm: Analog Accuracy 1 or better	1No.	AE/MECO/IMP/RISHAB
21	MVAR Meter 144x144mm : Analog, Accuracy 1 or better	1No.	AE/MECO/IMP/RISHAB
22	Energy meter Accuracy 0.2S	1No.	L&T/SECURE
23	Numerical Distance Relay	2 No.	ABB/ALSTOM/GE/SCHNEIDER/SEL/TOSHIBA/ SIEMENS
24	Master Trip Relay with ~~Hand~~ **electrical Reset**	1No.	ABB/ALSTOM/ SIEMENS
25	Trip Circuit supervision relays (TC1 & TC2)	2 set	ABB/ALSTOM/ SIEMENS
26	DC Supervision Relays	2 Nos.	ABB/ALSTOM/ SIEMENS

27	PT Voltage Selection Relays	1 set	ABB/ALSTOM/ SIEMENS
28	Master Trip Relay for Local Breaker Backup Protection	1 No.	ABB/ALSTOM/ SIEMENS
29	Dc Fail Accept & AC Supervision Relay	1 set	ABB/ALSTOM/ SIEMENS
30	Auxiliary Relays	As required	ABB/ALSTOM/ SIEMENS
31	Test Block for Energy meter	1 no.	AE/MECO/DAV
32	Relay Test Block for Main I Distance Relay	1 No.	ABB/ALSTOM/ SIEMENS
33	Test Blocks and Test Plugs for Main II Distance Relay	1 no.	ABB/ALSTOM/ SIEMENS
34	Multifunction Transducer Accuracy 0.2	1 No.	Rishabh/AE/MECO
35	Led Interior Lighting with door switch	1 set	Philips/ Havells/ Superior make
36	Multipin universal socket 15A with switch	1 set	Anchor/ Superior make
37	MCBs with auxiliary contact	As required	BUSSMAN/ SCHNEIDER/ SUPERIOR
38	Space Heater with Thermostat and control switch	1 set	GIRISH/SUPERIOR
39	Cable Gland	As Required	Superior make
40	Terminal Block 1100V Grade	As Required + 20% spares	Elmex/Connectwell
41	Tinned Copper Earth Bar 50x6mm	As Required	Superior make
42	Wires for connections/ earthing 1100V Grade, FRLS,ISI marked	As Required	Superior make
43	All other auxiliary relays, AC no volt relay with test Pushbutton, timers, contact multiplication, accessories ,etc required for proper functioning of protection and control scheme.		
44	Items required for erection of panels including anchor bolt, channels, levelling steel sills, antivibration pads, earth bar extension		
45	Test links, special terminal boards, other accessories required for testing, maintenance and operation.		

32.4.2. Sample Annunciator Facia Inscription for 110 kV Feeder C&R Panel - (Annunciator shall have 24 window facia to give following target Indications and shall be wired accordingly)

Sl.No.	Inscription
1	DISTANCE PROTECTION OPERATED
2	CARRIER RECEIVED
3	DISTANCE RELAY FAILED
4	AUTORECLOSER OPERATED
5	AUTO RECLOSE UNSUCESSFULL
6	SOTF OPERATED
7	PSB OPERATED
8	BRC OPERATED
9	VT FUSE FAIL
10	OC /EF PROTECTION OPERATED
11	LBB OPERATED
12	OC/EF PROT FAILED
13	CB SF6 LOW
14	CB LOCKOUT
15	CB SUPPLY FAIL
16	86 OPERATED
17	TC-1 FAIL
18	TC-2 FAIL
19	DC-1 FAIL
20	DC-2 FAIL
21	AC Fail
22	MCB TRIP
23	Spare
24	Spare

32.5.1. 33/11KV TRANSFORMER CONTROL & RELAY PANEL (HV SIDE ONLY) (Single Bus Arrangement)

Sl. No.	Item Description	Qty	Recommended Make *
1	Simplex Panel with Base frame (WXDXH) 800X800X 2300 mm	1 nos.	Superior make
2	Mimic Diagram	1 set	Superior make
3	Name Plate for Panel Designation Equipment Identification and Device labels (Inside and Out side)	1 set	Superior make
4	Semaphore indicators for Circuit Breaker 63mm Dia	1 No.	DAV/ Superior Make
5	Semaphore indicators for isolators 48mm	1 no.	DAV/ Superior Make
6	Control switch for circuit breaker : three position spring return to neutral position with lost motion device with locking arrangements.	1 no.	KAYCEE/RECOM/SWITRON
7	Switch for DC selection (Source 1-off-Source 2) Three position stay put	1 no.	KAYCEE/RECOM/SWITRON
8	Switch for LOCAL/ SCADA selection: two position, stay put	1No.	KAYCEE/RECOM/SWITRON
9	Indicating lamps (LED)with red (ON), green (OFF)and amber (AUTO TRIP) coloured lense for circuit breakers	3No.	DAV/TEKNIC/ESSEN
10	Indicating lamps (LED)with white lense for Trip Circuit Healthy 1&2	2 nos.	DAV/TEKNIC/ESSEN
11	Indicating lamps (LED)with red (ON) and green (OFF) coloured lense for Isolator	2 nos.	DAV/TEKNIC/ESSEN
12	Push Button for Alarm Accept and	3 Nos.	DAV/TEKNIC/ESSEN

	Trip Circuit Healthy 1 &2 Test		
13	Annunciator system: 24 window facia with built in push button for Accept, Reset and LampTest with warning annunciation- Hooter (for Trip), Bell (for Non-Trip), Buzzer (for DC Fail),etc.	1 set	ALAN/ BHARANI
14	Ammeter 144x144mm: Analog Accuracy 1 or better	3Nos.	AE/MECO/IMP/RISHAB
15	Voltmeter 72x144mm: Digital to show R_Y,Y_B,B_R voltages Accuracy 1 or better	3 Nos.	AE/MECO/IMP/RISHAB
16	Energy meter Accuracy 0.2S	1No.	L&T/SECURE
17	Numerical Directional Three Over Current and One Earthfault Relay	1 No.	ABB/ALSTOM/GE/SCHNEIDER / SEL/ SIEMENS
18	REF Relay with variable stabilising resistor	1 No.	CAG14
19	Master Trip Relay with electrical Reset	1No.	ABB/ALSTOM/ SIEMENS
20	Trip Circuit supervision relays	1 set	ABB/ALSTOM/ SIEMENS
21	DC Supervision Relay	1 set	ABB/ALSTOM/ SIEMENS
22	Auxiliary Relays for Trip and Close Circuit	1 set	ABB/ALSTOM/ SIEMENS
23	Auxiliary Relays for Transformer Supervision	12 Nos.	ABB/ALSTOM/ SIEMENS/
24	Auxiliary Relay for REF	As required	ABB/ALSTOM/ SIEMENS
25	Test Block for Energy meter	1 no.	AE/MECO/DAV
26	Test Blocks and Test Plugs for	1 no.	ABB/ALSTOM/ SIEMENS

	O/C+E/F Relay		
27	Multifunction Transducer Accuracy 0.2	1 No.	Rishabh/AE/MECO
28	Led Interior Lighting with door switch	1 set	Philips/ Havells/ Superior make
29	Multipin universal socket 15A with switch	1 set	Anchor/ Superior make
30	MCB with auxiliary contacts	As required	Siemens/ Scheider/Bussman
31	Space Heater with Thermostat and control switch	1 set	Girish/Superior
32	Cable Gland	As Required	Superior make
33	Terminal Block 1100V Grade	As Required + 20% spares	Elmex/Connectwell
34	Tinned Copper Earth Bar 50x6mm	As Required	Superior make
35	Wires for connections/ earthing 1100V Grade, FRLS,ISI marked	As Required	Superior make
36	All other auxiliary relays, AC no volt relay with test Pushbutton, timers, contact multiplication, accessories ,etc required for proper functioning of protection, intertrip and control scheme.		
37	Items required for erection of panels including anchor bolt, channels, levelling steel sills, antivibration pads, earth bar extension		
38	Test links, special terminal boards, other accessories required for testing, maintenance and operation.		

32.5.2. Sample Annunciator Facia Inscription for 33/11 kV Transformer C&R Panel (HV Side Only) (Annunciator shall have 24 window facia to give following target Indications and shall be wired accordingly)

Sl.No.	Inscription
1	SPARE
2	REF TRIP

3	OC /EF PROTECTION OPERATED
4	CB LOCKOUT
5	TRANSFORMER INTER TRIP
6	TRIP CIRCUIT FAIL
7	BUCHOLZ TRIP
8	OLTC BUCHOLZ TRIP
9	WTI TRIP
10	OIL TEMP TRIP
11	PRV TRIP
12	CB SF6 LOW
13	RELAY FAULTY
12	AC FAIL
15	CONTROL DC FAIL
16	ANN. DC FAIL
17	LOW OIL ALARM
18	BUCHOLTZ ALARM
19	WTI ALARM
20	OIL TEMP ALARM
21	MCB TRIP
22	OVER FLUX ALARM
23	OVER FLUX TRIP
24	SPARE

32.6.1. 110/11KV TRANSFORMER CONTROL & RELAY PANEL (HV SIDE ONLY) AND 110/33KV TRANSFORMER CONTROL & RELAY PANEL (HV SIDE) (Double Bus Arrangement)

Sl. No.	Item Description	Qty	Recommended Make *
1	Simplex Panel with Base frame(WXDXH) 950X800X 2300 mm	1 nos.	Superior make
2	Mimic Diagram	1 set	Superior make
3	Name Plate for Panel Designation Equipment Identification and Device labels (Inside and Out side)	1 set	Superior make
4	Semaphore indicators for Circuit Breaker 63mm Dia	1 No.	DAV/ Superior Make
5	Semaphore indicators for isolators 48mm	2 no.	DAV/ Superior Make
6	Control switch for circuit breaker : three position spring return to neutral position with lost motion device with locking arrangements.	1 no.	KAYCEE/RECOM/SWITRON
7	Switch for DC selection (Source 1-off-Source 2) Three position stay put	1 no.	KAYCEE/RECOM/SWITRON
8	Switch for LOCAL/ SCADA selection: two position, stay put	1No.	KAYCEE/RECOM/SWITRON
9	Indicating lamps (LED)with red (ON), green (OFF)and amber (AUTO TRIP) coloured lense for circuit breakers	3No.	DAV/TEKNIC/ESSEN
10	Indicating lamps (LED)with white lense for Trip Circuit Healthy 1&2 , DC Supply Fail (Amber)	3 nos.	DAV/TEKNIC/ESSEN
11	Indicating lamps (LED)with red (ON) and green (OFF) coloured lense for Isolators	4 nos.	DAV/TEKNIC/ESSEN
12	Push Button for Alarm Accept, Trip Circuit Healthy 1 &2 Test, DC Fail Accept	4 Nos.	DAV/TEKNIC/ESSEN

13	Annunciator system: 24 window facia with built in push button for Accept, Reset and LampTest with warning annunciation- Hooter (for Trip), Bell (for Non-Trip), Buzzer (for DC Fail),etc	1 set	ALAN/ BHARANI
14	Ammeter 144x144mm: Analog Accuracy 1 or better	3Nos.	AE/MECO/IMP/RISHAB
15	Voltmeter 72x144mm: Digital to show R_Y,Y_B,B_R voltages Accuracy 1 or better	3 Nos.	AE/MECO/IMP/RISHAB
16	MW Meter 144x144mm: Analog Accuracy 1 or better	1No.	AE/MECO/IMP/RISHAB
17	MVAR Meter 144x144mm : Analog, Accuracy 1 or better	1No.	AE/MECO/IMP/RISHAB
18	Energy meter Accuracy 0.2S	1No.	L&T/SECURE
19	Numerical Transformer Differential Protection Relay	2 No.	ABB/ALSTOM/GE/SCHNEIDER/SEL/TOSHIBA/ SIEMENS
20	Master Trip Relay with Hand Reset	1No.	ABB/ALSTOM/ SIEMENS
21	Trip Circuit supervision relays	1 set	ABB/ALSTOM/ SIEMENS
22	DC Supervision Relay	1 set	ABB/ALSTOM/ SIEMENS
23	AC Supply Supervision Relay	1 set	ABB/ALSTOM/ SIEMENS
24	Voltage Selection Relay	1 set	ABB/ALSTOM/ SIEMENS
25	Auxiliary Relays for Trip and Close Circuit	1 set	ABB/ALSTOM/ SIEMENS
25	Auxiliary Relay for REF	As required	ABB/ALSTOM/ SIEMENS
26	DC Fail Accept Relay	1 set	ABB/ALSTOM/ SIEMENS

27	Auxiliary Relay for Transformer Supervision	12 Nos.	ABB/ALSTOM/ SIEMENS
28	Test Blocks and Test Plugs for Main I & Main II Differential Protection	2 no.	ABB/ALSTOM/ SIEMENS
29	Test Blocks Energy Meter	1 no.	AE/MECO/DAV
30	Multifunction Transducer Accuracy 0.2	1 No.	Rishabh/AE/MECO
31	Led Interior Lighting with door switch	1 set	Philips/ Havells/ Superior make
32	Multipin universal socket 15A with switch	1 set	Anchor/ Superior make
33	MCB with auxiliary contacts	As required	Siemens/ Scheider/Bussman
34	Space Heater with Thermostat and control switch	1 set	Girish/Superior
35	Cable Gland	As Required	Superior make
36	Terminal Block 1100V Grade	As Required + 20% spares	Elmex/Connectwell
37	Tinned Copper Earth Bar 50x6mm	As Required	Superior make
38	Wires for connections/ earthing 1100V Grade, FRLS,ISI marked	As Required	Superior make
39	All other auxiliary relays, AC no volt relay with test Pushbutton, timers, contact multiplication, accessories ,etc required for proper functioning of protection, intertrip and control scheme.		
40	Items required for erection of panels including anchor bolt, channels, levelling steel sills, antivibration pads, earth bar extension		
41	Test links, special terminal boards, other accessories required for testing, maintenance and operation.		

32.7.1. 110/33KV TRANSFORMER CONTROL & RELAY PANEL (LV SIDE) (Single Bus Arrangement)

Sl. No.	Item Description	Qty	Recommended Make *
1	Simplex Panel with Base frame(WXDXH) 700X800X 2300 mm	1 nos.	Superior make
2	Mimic Diagram	1 set	Superior make
3	Name Plate for Panel Designation Equipment Identification and Device labels (Inside and Out side)	1 set	Superior make
4	Semaphore indicators for Circuit Breaker 63mm Dia	1 No.	DAV/ Superior Make
5	Semaphore indicators for isolators 48mm	1 no.	DAV/ Superior Make
6	Control switch for circuit breaker : three position spring return to neutral position with lost motion device with locking arrangements.	1 no.	KAYCEE/RECOM/SWITRON
7	Switch for DC selection (Source 1-off-Source 2) Three position stay put	1 no.	KAYCEE/RECOM/SWITRON
8	Switch for LOCAL/ SCADA selection: two position, stay put	1No.	KAYCEE/RECOM/SWITRON
9	Indicating lamps (LED)with red (ON), green (OFF)and amber (AUTO TRIP) coloured lense for circuit breakers	3No.	DAV/TEKNIC/ESSEN
10	Indicating lamps (LED)with white lense for Trip Circuit Healthy 1&2 , DC Supply Fail (Amber)	3 nos.	DAV/TEKNIC/ESSEN
11	Indicating lamps (LED)with red (ON) and green (OFF) coloured lense for Isolator	2 nos.	DAV/TEKNIC/ESSEN
12	Push Button for Alarm Accept, Trip Circuit	4 Nos.	DAV/TEKNIC/ESSEN

	Healthy 1 &2 Test, DC Fail Accept		
13	Annunciator system: 12 window facia with built in push buttons for Accept, Reset and LampTest with warning annunciation-Hooter (for Trip), Bell (for Non-Trip), Buzzer (for DC Fail),etc	1 set	ALAN/ BHARANI
14	Ammeter 144x144mm: Analog Accuracy 1 or better	3Nos.	AE/MECO/IMP/RISHAB
15	Voltmeter 72x144mm: Digital to show R_Y, Y_B,B_R voltages, Accuracy 1 or better	3 Nos.	AE/MECO/IMP/RISHAB
16	Master Trip Relay with electrical Reset	1No.	ABB/ALSTOM/ SIEMENS
17	Trip Circuit supervision relays	1 set	ABB/ALSTOM/ SIEMENS
18	DC Supervision Relay	1 set	ABB/ALSTOM/ SIEMENS
19	AC Supply Supervision Relay	1 set	ABB/ALSTOM/ SIEMENS
20	Auxiliary Relays for Trip and Close Circuit	1 set	ABB/ALSTOM/ SIEMENS
21	Auxiliary Relay for REF	As required	ABB/ALSTOM/ SIEMENS
22	DC Fail Accept Relay	1 set	ABB/ALSTOM/ SIEMENS
23	Multifunction Transducer Accuracy 0.2	1 No.	Rishabh/AE/MECO
24	Led Interior Lighting with door switch	1 set	Philips/ Havells/ Superior make
25	Multipin universal socket 15A with switch	1 set	Anchor/ Superior make
25	MCB with auxiliary contacts	As required	Siemens/BussMan/ Schneider
26	Space Heater with Thermostat and control switch	1 set	
27	Cable Gland	As Required	Superior make
28	Terminal Block 1100V Grade	As Required +	Elmex/Connectwell

		20% spares	
29	Tinned Copper Earth Bar 50x6mm	As Required	Superior make
30	Wires for connections/ earthing 1100V Grade, FRLS,ISI marked	As Required	Superior make
31	All other auxiliary relays, AC no volt relay with test Push button, timers, contact multiplication, accessories ,etc required for proper functioning of protection, intertrip and control scheme.		
32	Items required for erection of panels including anchor bolt, channels, levelling steel sills, antivibration pads, earth bar extension		
33	Test links, special terminal boards, other accessories required for testing, maintenance and operation.		

32.7.2. Sample Annunciator Facia Inscription for 110/33 kV Transformer C&R Panel (LV SIDE) - (Annunciator shall have 12 window facia to give following target Indications and shall be wired accordingly)

Sl.No.	**Inscription**
1	OC /EF PROTECTION OPERATED
2	LBB PROTECTION OPERATED
3	REF PROTECTION OPERATED
4	33KV TRIP CIRCUIT FAULTY
5	PROTECTIVE RELAY FAULTY
6	AC SUPPLY FAIL
7	DC SUPPLY FAIL
8	ANNUNCIATION DC SUPPLY FAIL
9	MCB TRIP
10	SPARE
11	SPARE

12	SPARE

32.8.1. 220 kV FEEDER CONTROL & RELAY PANEL:- one set of two simplex panels so that Main I relay in one panel and Main II Relay in second panel.

Sl. No.	Item Description	Qty	Recommended Make *
1	700mm wide Panel	2 nos.	Superior make
2	Mimic Diagram	1 set	Superior make
3	Name Plate for Panel Designation Equipment Identification and Device labels (Inside and Out side)	1 set	Superior make
4	Semaphore indicators for Circuit Breaker	1 No.	DAV/ Superior Make
5	Semaphore indicators for isolators	3 no.	DAV/ Superior Make
6	Semaphore indicators for earth switch	1 no.	DAV/ Superior Make
7	Control switch for circuit breaker : three position spring return to neutral position with lost motion device with locking arrangements.	1 no.	KAYCEE/RECOM/SWITRON
8	Control switch for Isolator three position spring return to neutral position	3 Nos.	KAYCEE/RECOM/SWITRON
9	Switch for DC selection (Source 1-off-Source 2) for Main I and Main 2:	2 no.	KAYCEE/RECOM/SWITRON

	Three position stay put		
10.	Switch for Auto Reclose selection (NA-1ph-3ph-1&3ph): four position, stay put,	1 No.	KAYCEE/RECOM/SWITRON
11	Switch for carrier source selection IN/OUT positions; Two position, stay put	1 No.	KAYCEE/RECOM/SWITRON
12	Switch for LOCAL/ SCADA selection: two position, stay put	1No.	KAYCEE/RECOM/SWITRON
13	Switch for synchronisation –Keyed-Deadline/ Live Line/ Bypass mode: Three position, stay put	1No.	KAYCEE/RECOM/SWITRON
14	Indicating lamps (LED)with red, green and amber coloured lense(amber for auto trip) for circuit breakers	3No.	TEKNIC/ Superior make
15	Indicating lamps (LED)with red, green for Isolators and Earth Switch	4 set	TEKNIC/ Superior make
16	Space Heater	1 No.	
17	Test Blocks for Energy Meter	As required	IMP/Superior make
18	Test blocks for Relays with Test Plugs	As required	ABB/ALSTOM/GE/SIEMENS/ ALSTOM/SCHNEIDER
19	Push Button for Accept/Reset/ Lamp test of Annunciator and DC1 /DC2	5 Nos.	TEKNIC/ Superior make

	supply fail Test		
20	Led Interior Lighting with door switch	1 set	Philips/ Havells/ Superior make
21	Multipin universal socket 15A with switch	1 set	Anchor/ Superior make
22	MCBs/ Fuses/Links	As required	Busman/ Schneider/ Superior make
23	Annunciator system: 24 window facia with push buttons for testing emergency,and warning annunciation, bell, hooter,etc	1 set	ALAN/ BHARANI
24	Ammeter : Analog of scale range 0-800A-1600	3Nos.	AE/MECO/Superior make
25	Voltmeter: Digital to show R_Y,Y_B,B_R voltages	3 Nos.	AE/MECO/Superior make
26	Wattmeter: Analog of scale range (-) 400MW-0-(+)400MW	1No.	AE/MECO/Superior make
27	VAR meter: Analog of scale range (-) 100MVAR-0-(+)100MVAR	1No.	AE/MECO/Superior make
28	TOD Energy meter	1No.	L&T/SECURE
29	Multifunction Transducer	1No.	Rishabh (Rish Ducer M 40) /Superior
30	Numerical distance relay to operate as Main I	1No.	ABB REL 670/

31	Numerical distance relay to operate as Main II	1No	SIEMENS 7SA522/ SEL 421/ GE D60/ ALSTOM /SCHNEIDER MiCOM P444
32	Bus PT selection relay	2 No.	ABB/ALSTOM/SCHNEIDER/ SIEMENS
33	TC supervision relays	6 Nos.	ABB/ALSTOM/SCHNEIDER/ SIEMENS
34	DC supply monitoring relays	2 No.	ABB/ALSTOM/SCHNEIDER/ SIEMENS
35	High speed tripping relay	3 No.	ABB/ALSTOM/SCHNEIDER/ SIEMENS
36	Master Trip Relay with electrical reset	2 No.	ABB/ALSTOM/SCHNEIDER/ SIEMENS
37	High speed CB Closing relay	1No.	ABB/ALSTOM/SCHNEIDER/ SIEMENS
38	Synchronising socket with shorting plug	1 Set	Superior make
39	Test Block for Energy meter	1 set	Superior make
40	Test Blocks and Test Plugs for Relays	As required	Superior make
41	Cable Gland	As Required	Superior make
42	Terminal Block 1100V Grade	As Required + 20% spares	Elmex/Connectwell
43	Tinned Copper Earth Bar 50x6mm	As Required	Superior make

44	Wires for connections/ earthing 1100V Grade, FRLS,ISI marked	As Required	Superior make
45	All other auxiliary relays, timers, contact multiplication, accessories ,etc required for proper functioning of protection and control scheme.		
46	Items required for erection of panels including achor bolt, channels, levelling steel sills, antivibration pads, earth bar extension		
47	Test links, special terminal boards, other accessories required for testing, maintenance and operation.		

Annunciator (item 23) shall have 24 window facia to give following target Indications and shall be wired accordingly.

1) Distance protection operated.(Main I)
2) Distance protection operated (Main II)
3) Bus protection operated.
4) Breaker reclosed.
5) Breaker failure protection operated.
6) Breaker trip circuit I faulty.
7) Breaker trip circuit II faulty
8) Breaker lock-out
9) Carrier fail.
10) Back up protection operated.
11) P.T. Fuse failed.
12) SOTF protection operated.
13) Power Swing detected.
14) Direct trip received.
15) Carrier received.
16) Breaker pole discrepancy.
17) Breaker low SF 6.
18) Breaker low air/spring discharged.

19) Auto reclose lock out.
20) DC1 Fail
21) DC2 Fail
22) Aux. A.C. fail
23) Spare
24) Spare

32.9.1. 220/110KV TRANSFORMER CONTROL & RELAY PANEL (HV SIDE) (Double Bus Arrangement):-

Sl. No.	Item Description	Qty	Recommended Make *
1	Simplex Panel with Base frame(WXDXH) 950X800X 2300 mm	1 nos.	Superior make
2	Mimic Diagram	1 set	Superior make
3	Name Plate for Panel Designation Equipment Identification and Device labels (Inside and Out side)	1 set	Superior make
4	Semaphore indicators for Circuit Breaker 63mm Dia	1 No.	DAV/ Superior Make
5	Semaphore indicators for isolators 48mm Dia	2 no.	DAV/ Superior Make
6	Control switch for circuit breaker : three position spring return to neutral position with lost motion device with locking arrangements.	1 no.	KAYCEE/RECOM/SWITRON
7	Isolator Control Switch : three position spring return to neutral position	2 no.	
8	Switch for DC selection (Source 1-off-Source 2) Three position stay put	2 no.	KAYCEE/RECOM/SWITRON

9	Switch for LOCAL/ SCADA selection: two position, stay put	1No.	KAYCEE/RECOM/SWITRON
10	Indicating lamps (LED)with red (ON), green (OFF)and amber (AUTO TRIP) coloured lense for circuit breakers	3No.	TEKNIC/ Superior make
11	Indicating lamps (LED)with white lense for Trip Circuit Healthy 1&2 , DC Supply Fail (Amber)	3 nos.	TEKNIC/ Superior make
12	Indicating lamps (LED)with red (ON) and green (OFF) coloured lense for Isolators	4 nos.	TEKNIC/ Superior make
13	Push Button for Alarm Accept, Trip Circuit Healthy 1 &2 Test, DC Fail Accept	4 Nos.	TEKNIC/ Superior make
14	Annunciator system: 24 window facia with built in push button for Accept, Reset and LampTest with warning annunciation-Hooter (for Trip), Bell (for Non-Trip), Buzzer (for DC Fail),etc	1 set	ALAN/ BHARANI
15	Ammeter 144x144mm: Analog Accuracy 1 or better	3Nos.	AE/MECO/Superior make
16	Voltmeter 72x144mm: Digital to show R_Y,Y_B,B_R voltages Accuracy 1 or better	3 Nos.	AE/MECO/Superior make
17	MW Meter 144x144mm: Analog Accuracy 1 or better	1No.	AE/MECO/Superior make
18	MVAR Meter 144x144mm : Analog, Accuracy 1 or better	1No.	AE/MECO/Superior make
19	Energy meter Accuracy 0.2S	1No.	L&T/SECURE

20	Numerical Transformer Differential Protection Relay Main I & II	2 No.	ABB/ALSTOM/SIEMENS/GE/ SCHNEIDER/SEL
21	Master Trip Relay with Hand Reset	2No.	ABB/ALSTOM/SIEMENS/GE/ SCHNEIDER/SEL
22	Trip Circuit supervision relays	2 set	ABB/ALSTOM/SIEMENS/GE/ SCHNEIDER/SEL
23	Voltage Selection Relay	1 set	ABB/ALSTOM/SIEMENS/GE/ SCHNEIDER/SEL
24	DC Supply Supervision Relay	1 set	ABB/ALSTOM/SIEMENS/GE/ SCHNEIDER/SEL
25	AC Supply Supervision Relay	1 set	ABB/ALSTOM/SIEMENS/GE/ SCHNEIDER/SEL
26	Auxiliary Relays for Trip and Close Circuit	1 set	ABB/ALSTOM/SIEMENS/GE/ SCHNEIDER/SEL
27	Circuit Breaker Supervision Relay	1 set	ABB/ALSTOM/SIEMENS/GE/ SCHNEIDER/SEL
28	Auxiliary Relays for Transformer monitoring	As required	
29	DC Fail Accept Relay	1 set	ABB/ALSTOM/SIEMENS/GE/ SCHNEIDER/SEL
30	Test Blocks and Test Plugs for Main I Differential Relay	1 no.	Superior make
31	Test Blocks and Test Plugs for Main II Differential Relay	1 no.	Superior make
32	Multifunction Transducer Accuracy 0.2	1 No.	Rishabh/AE/MECO
33	LED Interior Lighting with door switch	1 set	Philips/ Havells/ Superior make

34	Multipin universal socket 15A with switch	1 set	Anchor/ Superior make
35	MCBs with auxiliary contact	As required	BUSSMAN/ SCHNEIDER/ SUPERIOR
36	Space Heater with Thermostat and control switch	1 set	Superior make
37	Cable Gland	As Required	Superior make
38	Terminal Block 1100V Grade	As Required + 20% spares	Elmex/Connectwell
39	Tinned Copper Earth Bar 50x6mm	As Required	Superior make
40	Wires for connections/ earthing 1100V Grade, FRLS,ISI marked	As Required	Superior make
41	All other auxiliary relays, AC no volt relay with test Pushbutton, timers, contact multiplication, accessories ,etc required for proper functioning of protection, intertrip and control scheme.		
42	Items required for erection of panels including anchor bolt, channels, levelling steel sills, antivibration pads, earth bar extension		
43	Test links, special terminal boards, other accessories required for testing, maintenance and operation.		

Sample Annunciator Facia Inscription for 220/110 kV Transformer C&R Panel (HV SIDE) - (Annunciator shall have 24 window facia to give following target Indications and shall be wired accordingly)

Sl. No.	**Inscription**
1	DIFFERENTIAL PROTECTION TRIP
2	HV REF TRIP
3	HV OC /EF PROTECTION OPERATED
4	POLE DISCREPANCY TRIP
5	OVER FLUX OPERATED

6	PROTECTIVE RELAY FAULTY
7	TRANSFORMER LV INTERTRIP
8	CB SF6 GAS PRESSURE LOW ALARM
9	CB SF6 GAS PRESSURE LOW LOCKOUT
10	CB SPRING DISCHARGED
11	220KV CB TRIP CIRCUIT FAULTY
12	AC SUPPLY FAIL
13	DC SUPPLY I FAIL
14	DC SUPPLY II FAIL
15	MCB TRIP
16	ANNUNCIATION DC SUPPLY FAIL
17	SPARE
18	SPARE
19	SPARE
20	SPARE
21	SPARE
22	SPARE
23	SPARE
24	SPARE

32.9.2. 220/110KV TRANSFORMER CONTROL & RELAY PANEL (LV SIDE) -**(DOUBLE BUS ARRANGEMENT)**

Sl. No.	**Item Description**	**Qty**	**Recommended Make ***
1	Simplex Panel with Base frame(WXDXH) 700X800X 2300 mm	1 nos.	Superior make
2	Mimic Diagram	1 set	Superior make
3	Name Plate for Panel Designation Equipment Identification and	1 set	Superior make

	Device labels (Inside and Out side)		
4	Semaphore indicators for Circuit Breaker 63mm Dia	1 No.	DAV/ Superior Make
5	Semaphore indicators for isolators 48mm Dia	2 no.	DAV/ Superior Make
6	Control switch for circuit breaker : three position spring return to neutral position with lost motion device with locking arrangements.	1 no.	KAYCEE/RECOM/SWITRON
7	Synchronising Selector Switch : Two position , with locking arrangement .	1 no.	
8	Switch for DC selection (Source 1-off-Source 2) Three position stay put	1 no.	KAYCEE/RECOM/SWITRON
9	Switch for LOCAL/ SCADA selection: two position, stay put	1No.	KAYCEE/RECOM/SWITRON
10	Indicating lamps (LED)with red (ON), green (OFF)and amber (AUTO TRIP) coloured lense for circuit breakers	3No.	TEKNIC/ Superior make
11	Indicating lamps (LED)with white lense for Trip Circuit Healthy 1&2 , DC Supply Fail (Amber)	3 nos.	TEKNIC/ Superior make
12	Indicating lamps (LED)with red (ON) and green (OFF) coloured lense for Isolators	4 nos.	TEKNIC/ Superior make
13	Push Button for Alarm Accept, Trip Circuit Healthy 1 &2 Test, DC Fail Accept	4 Nos.	TEKNIC/ Superior make
14	Annunciator system: 24 window facia with built in push button for Accept, Reset and LampTest with warning annunciation- Hooter (for Trip), Bell (for Non-Trip), Buzzer (for DC Fail),etc	1 set	ALAN/ BHARANI
15	Ammeter 144x144mm: Analog Accuracy 1 or better	3Nos.	AE/MECO/Superior make
16	Voltmeter 72x144mm: Digital to show	3 Nos.	AE/MECO/Superior make

	R_Y,Y_B,B_R voltages Accuracy 1 or better		
17	Master Trip Relay with Hand Reset	2No.	ABB/ALSTOM/SIEMENS/GE /SCHNEIDER/SEL
18	Trip Circuit supervision relays	2 set	ABB/ALSTOM/SIEMENS/GE /SCHNEIDER/SEL
19	Voltage Selection Relay	1 set	ABB/ALSTOM/SIEMENS/GE /SCHNEIDER/SEL
20	DC Supply Supervision Relay	1 set	ABB/ALSTOM/SIEMENS/GE /SCHNEIDER/SEL
21	AC Supply Supervision Relay	1 set	ABB/ALSTOM/SIEMENS/GE /SCHNEIDER/SEL
22	Auxiliary Relays for Trip and Close Circuit	1 set	ABB/ALSTOM/SIEMENS/GE /SCHNEIDER/SEL
23	Auxiliary Relay for Transformer monitoring	As required	ABB/ALSTOM/SIEMENS/GE /SCHNEIDER/SEL
24	DC Fail Accept Relay	1 set	ABB/ALSTOM/SIEMENS/GE /SCHNEIDER/SEL
25	Synchronising Socket	1 no.	Superior make
27	Multifunction Transducer Accuracy 0.2	1 No.	Rishabh/AE/MECO
28	LED Interior Lighting with door switch	1 set	Philips/ Havells/ Superior make
29	Multipin universal socket 15A with switch	1 set	Anchor/ Superior make
30	MCBs with auxiliary contact	As required	BUSSMAN/ SCHNEIDER/ SUPERIOR
31	Space Heater with Thermostat and control switch	1 set	Superior make
32	Cable Gland	As Required	Superior make
33	Terminal Block 1100V Grade	As Required +	Elmex/Connectwell

		20% spares	
34	Tinned Copper Earth Bar 50x6mm	As Required	Superior make
35	Wires for connections/ earthing 1100V Grade, FRLS,ISI marked	As Required	Superior make
36	All other auxiliary relays, AC no volt relay with test Pushbutton, timers, contact multiplication, accessories ,etc required for proper functioning of protection, intertrip and control scheme.		
37	Items required for erection of panels including anchor bolt, channels, levelling steel sills, antivibration pads, earth bar extension		
38	Test links, special terminal boards, other accessories required for testing, maintenance and operation.		

SAMPLE ANNUNCIATOR FACIA INSCRIPTION FOR 220/110 KV TRANSFORMER C&R PANEL (LV SIDE) - (ANNUNCIATOR SHALL HAVE 24 WINDOW FACIA TO GIVE FOLLOWING TARGET INDICATIONS AND SHALL BE WIRED ACCORDINGLY)

Sl.No.	Inscription
1	LV MASTER TRIP RELAY OPERATED
2	110KV CB TRIP CIRCUIT FAULTY
3	BUCHOLZ TRIP
4	WINDING TEMP HIGH TRIP
5	OIL TEMP HIGH TRIP
6	OLTC BUCHOLZ TRIP
7	BUCHOLZ ALARM
8	WINDING TEMP HIGH ALARM
9	OIL TEMP HIGH ALARM
10	OLTC BUCHOLZ ALARM
11	PRV TRIP
12	OSR TRIP

13	OLTC LOW OIL LEVEL ALARM
14	MAIN TANK LOW OIL LEVEL ALARM
15	CB SF6 GAS PRESSURE LOW ALARM
16	CB SF6 GAS PRESSURE LOW LOCKOUT
17	CB SPRING DISCHARGED
18	AC SUPPLY FAIL
19	DC SUPPLY FAIL
20	MCB TRIP
21	ANNUNCIATION DC SUPPLY FAIL
22	SPARE
23	SPARE
24	SPARE

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**.**

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. The drawing shall include **Cover Page, General Arrangement, Schematic , Terminal Connections and Bill of Materials** which are serially numbered.

33.2.1. Cover Page: Shall include Name of Panel, Customer Name, P.O. Ref, Drawing Number, Revision History of each sheet, Total number of sheets, etc .

33.2.2. Second Page shall give table containing description of each sheet.

33.2.3. General Arrangement drawing shall include

a) Technical details of panel construction, general description, terminal notations,etc.

b) Principal dimension details of each unit cubicles, complete assembly of panel.

c) Front and rear views of the Panel with instrument and device positions marked.

d) Foundation drawings and floor plans of control and Relay panels. Location of foundation bolts, cable slots and weights shall also be given on these drawings.

e) Pictorial views of the Control Switches Terminal Blocks, Indication Instruments, Test Blocks and exploded views of draw out type instructions and Fuse Blocks.

f) Name Plate , Rating Plate details

g) Legend sheet describing symbolic representation of components.

33.2.4. Schematic Diagram sheets shall include circuit diagrams including the following:

a) Single line diagram showing power circuit, protection and metering for each panel.

b) AC & DC Distibution circuits.

c) Indication circuits

d) Metering Circuits

e) Complete schematic drawings for annunciation system.

f) Protection circuits

g) voltage selection schemes

h) Tripping circuits

i) Closing Circuits

j) Supervision Circuits

k)Contact development drawings of all switches, relays etc.

l)Trip Matrics and Inter locking Schemes.

m) Terminal Connection diagrams and wiring schedule.

n) Complete AC and DC Schematic drawings of elements of control and relay boards. These show all A.C. power connection and secondary connection for relay, meters etc. with vector relationship.

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.

33.2.5. Bill of Materials showing quantity and description (Make, Model No., specification,etc) of all components used in line with specification. List of spares supplied with each panel also to be included in a separate sheet included in drawing.

33.2.6. Relevant Illustrative, descriptive literature shall be furnished.

33.3 Normally 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.

33.6. It is desired that the complete schematic drawing is provided on a permanently laminated/engraved plate of suitable thickness which has to be bolted/riveted at the four corners on the inside face of rear door. In addition, one more plate of similar type and dimension shall be provided on the outside of the rear door providing guidelines and instructions for operation. The guidelines and schematic to be provided on the plates shall be as per approved drawings.

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 commissioning Manuals in suitable files (hard copy as well as soft copy)

1) 2 sets per Control & Protection Panels shall be sent to concerned substation.
2) 2 sets per Control & Protection Panels shall be sent to consignee before the dispatch of equipment.
3) 1set per Control & Protection Panels 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 each in Auto CAD & pdf format 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/Meters:-

Full version of relay communication software with all features including software for Disturbance Record Analyser,**multi user licensed (atleast for 10 users)** ~~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 have graphic capabilities for display and suitable interface to generate user defined reports in addition to the standard report forms. The interfacing cables and/ or interfacing devices required for communicating with the relay may be supplied along with relay testing and communication 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 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.

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.

   1) Name of consignee
   2) Details of consignment-P.O/Name of Item/Sl.No.,etc
   3) Destination
   4) Total weight of consignment
   5) Sign showing upper/lower side of the crate
   6) Handling and packing instructions
   7) 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.

Sd/-

CHIEF ENGINEER (SCM)

Guaranteed Technical Particulars Control and Relay Panels with Spares

(A)	Control & Relay Panels	
1	Name of Manufacturer	
2	Type and Designation/Model	
3	Conforming Standard	
4	Type of Construction	
5	Dimension of each Panel excluding Base frame HxWxD in mm 33kV Feeder 66kv feeder 110kV Feeder 220kV Feeder Main I 220kV Feeder Main II 33/11kV (Trfr HV Side) 66/11kv (Trfr HV Side) 110/11kV Trfr (HV Side) 110/33kV Trfr (HV Side) 110/33kV Trfr (LV Side) 220/110kV Trfr (HV Side) 220/110kV Trfr (LV Side)	
6	Number of doors on back side 33kV Feeder 66kv feeder 110kV Feeder 220kV Feeder Main I 220kV Feeder Main II 33/11kV (Trfr HV Side) 66/11kv (Trfr HV Side) 110/11kV Trfr (HV Side)	

	110/33kV Trfr (HV Side) 110/33kV Trfr (LV Side) 220/110kV Trfr (HV Side) 220/110kV Trfr (LV Side)	
7	Height of Base frame	
8	Type of Anti vibration Pad & it's thickness in mm	
9	Over all height of Panel in mm	
10	Degree of Ingress Protection & Protection Standard	
11	Type test report attached or not	
12	Material of Panel enclosure	
13	Thickness of sheet steel Front/Sides/Back in mm	
14	Material of gaskets	
15	Whether document holder provided on door	
16	Whether sheet steel phosphated as per IS-6005	
17	Whether painting done as per Cl.6	
18	Finishing paint:Powder coating or not	
19	No. of Quotes/ Total thickness of finishing paint in micron.	
20	Total weight of Main panel	
21	Total weight of Main II panel	
B	**PANEL WIRING**	
1	Name of Cable Manufacturer	
2	Type and Designation of Cable	

3	Conforming Standard	
4	Whether PVC insulated FRLS cable used	
5	Voltage Grade of Cable	
6	No. of Cores/ Stranded or not/ Tinned Copper or not	
7	Size of conductor for Auxiliary AC Supply	
8	Size of conductor for CT /PT/DC Aux. Circuit	
9	Size of conductor for other Circuits	
10	Type of terminals provided on wiring	
11	**Whether all the terminals of relays and components are accessible from rear side**	**Yes/No**
C	**TERMINAL BLOCK**	
1	Name of Manufacturer	
2	Type and Model of Terminal Block	
3	Type and Model of Terminal Block for PT	
4	Type and Model of Terminal Block for CT	
5	Conforming Standard	
6	Voltage Grade (1100V required)	
7	Continuous Current Rating in A	
8	Material used	
9	Maximum no. of cables that can be connected	
10	% & Number of spare terminals provided	
11	Transparent removable covers provided or not	
D	**MIMIC DIAGRAM**	

1	Material of Mimic Diagram		
2	Method of fixing (screwed or not)		
3	Colour of Mimic Diagram 11kV 33kV 66kV 110kV 220k Earth		
E	**NAME PLATE AND MARKINGS**		
1	Material of Name Plate & Colour		
2	Letters Punched or Engraved (Cl. 8.g)		
3	Whether Identification label as per Cl 9 provided		
F	**SEMAPHORE INDICATORS**	**CB**	**Isol/ Earth switch**
1	Name of Manufacturer		
2	Type and Model for CB/Isol		
3	No. of Positions		
4	Diameter of the disc		
5	Operating Voltage(Volts)		
6	Burden (Watts)		
7	Whether latch in mechanism provided Yes/No		
8	Status on loss of power		
9	Colour of Strip		
G.1	**CIRCUIT BREAKER CONTROL SWITCH**		
1	Make		
2	Model		

3	Whether Spring Return to Neutral with lost motion device and locking facility	
4	No. of positions	
5	Type of handle	
6	No. of ways in each position	
7	Making & Breaking capacity of contacts	
8	No. of mechanical operations	
9	Whether locking arrangement provided or not	
10	Whether Red Colour handle/ Base Provided	
G.2	**ISOLATOR CONTROL SWITCH**	
1	Make	
2	Model	
3	Whether Spring Return to Neutral with lost motion device and locking facility	
4	No. of positions	
5	Type of handle	
6	No. of ways in each position	
7	Making & Breaking capacity of contacts	
8	No. of mechanical operations	
G.3	**DC SELECTION SWITCH**	
1	Make	
2	Model	
3	Whether Stay put type	
4	No. of positions	
5	Type of handle	
6	No. of ways in each position	

7	Making & Breaking capacity of contacts	
8	No. of mechanical operations	
G.4	**AUTORECLOSE SELECTION SWITCH**	
1	Make	
2	Model	
3	Whether Stay put type	
4	No. of positions	
5	Type of handle	
6	No. of ways in each position	
7	Making & Breaking capacity of contacts	
8	No. of mechanical operations	
G.5	**CARRIER SOURCE SELECTION SWITCH**	
1	Make	
2	Model	
3	Whether Stay put type	
4	No. of positions	
5	Type of handle	
6	No. of ways in each position	
7	Making & Breaking capacity of contacts	
8	No. of mechanical operations	
G.6	**LOCAL/SCADA SELECTION SWITCH**	
1	Make	
2	Model	
3	Whether Stay put type	
4	No. of positions	
5	Type of handle	

6	No. of ways in each position	
7	Making & Breaking capacity of contacts	
8	No. of mechanical operations	
G.7	**SYNCHRONISATION SELECTION SWITCH**	
1	Make	
2	Model	
3	Whether Stay put type and locking facility	
4	No. of positions	
5	Type of handle	
6	No. of ways in each position	
7	Making capacity of contacts	
8	Breaking capacity of contacts	
H	**INDICATING LAMPS**	
1	Make	
2	Type / Model	
3	Operating Voltage (Volts)	
4	Size of lens (mm)	
5	Wattage of LEDs(Watts)	
6	Colour of LED covers	
7	LED Replacement method	
8	Whether Series connected Resistance provided	
9	Whether Integral engraved plate provided.	

I	**SPACE HEATER/ THERMOSTAT**	
1	Make	
2	Rating V, Hz, W	
3	Thermostat Make	
4	Thermostat Rated Voltage, Temp Setting Range	
J	**TEST BLOCK**	
1	Make (For Energy Meter)	
2	Type / Model (For Energy Meter)	
3	Make of Relay Test Block	
4	Type/ Model of Relay Test Block	
5	Whether Relay Test Block have facility to short the CT connections internally, upon plugging without using any shorting wires externally	
K	**PUSH BUTTON**	
1	Make	
2	Type/Model	
3	Contact Type (Momentary/ Maintained)/Material	
4	Whether shrouding provided to prevent in advertant operations?	
5	Number of No/NC Contacts	
6	Making / Carry Current	
7	Breaking Current	
L	**Interior Lighting and Receptacle**	
1	Interior lighting make/Type/ Rating	
2	Whether Door Switch for light provided/ Make/Type	

3	Universal Multi pin socket (15A) Make/ Rating	
4	Whether ISI marked	
M	**Fuses and MCB**	
1	Make of MCB	
2	Whether MCB is ISI marked	
3	Make of Fuse/ Links	
4	Whether Fuses are ISI marked	
N		
1	Make	
2	Type and Model No.	
3	No. of Windows 33kV Feeder 110kV Feeder 220kV Feeder Main I 220kV Feeder Main II 33/11kV (Trfr HV Side) 110/11kV Trfr (HV Side) 110/33kV Trfr (HV Side) 110/33kV Trfr (LV Side) 220/110kV Trfr (HV Side) 220/110kV Trfr (LV Side)	
4	Annunciator Dimension (LxWxD) in mm Window Dimension in mm	
5	Supply Voltage	
6	Permissible Voltage variation	
7	Power Consumption per window	

8	Fault input contact (Potential Free NO/NC)	
9	Minimum duration of impulse for initiating contact	
10	Contact Rating of auxiliary relay provided.	
11	Flickering speed of windows	
12	Whether AC Failure and DC Failure feature included	
13	Is the sequence of operation as per specification	
14	Push Buttons for Emergency/ Warning test: Integral or External.	
15	Buzzer/ Hooter: Inegral or External- If external they shall be provided	
O	**EARTHING**	
1	Size of Earth Bus Bar	
2	Material of Earth Bar	
3	Conductor size for earth connection from body of component devices	
4	Colour of earthing wire	
5	Size of earthing pad	
P	**Indicating and Integrating meters**	
P.1	**Multi Function Meter**	
1	Make	
2	Type & Model No.	
3	Conforming Stand	
4	Physical dimensions	
5	Nominal input Voltage	
6	Nominal input Current	

7	Frequency	
8	Burden	
9	Display Unit details	
10	Displayed parameters	
11	Communication port details	
12	Communication protocols supported	
P.1	**Ammeter**	
1	Make	
2	Type & Model No.	
3	Conforming Standard	
4	Rated Current	
5	Size	
6	Accuracy	
7	CT Ratio	
8	Burden	
P.2	**Voltmeter**	
1	Make	
2	Type & Model No.	
3	Conforming Standard	
4	Rated voltage/ Burden/ Accuracy	
5	Size	
6	Size of Digits/No. of Digits/No. of decimals	
7	Whether super bright LEDs used	
8	Maximum Value of Voltage Scale 33kV	

	66kV 110kV 220kV	
P.3	**Watt Meter / VAR Meter**	
1	Make	
2	Type & Model No.	
3	Conforming Standard	
4	Rated voltage/ Current/Burden/ Accuracy	
5	Size	
6	Whether suitable for power flow in both direction	
7	Whether three element type and suitable for 3 ph 4 wire unbalanced system	
P.4	**TOD ENERGY METER**	
1	Make	
2	Model No.	
3	Type (3 ph, 3 Element, 4 wire)	
4	Accuracy	
5	Rated voltage/ Current	
6	VA Burden of CTs/PTs	
7	Display Parameters	
8	No. of modes of display	
9	Maximum No. of decimal places in Mode 3	
10	Whether retain last recorded reading in case of power failure/ Furnish details	
11	Whether display both import and export	
12	Whether having Data logging and data	

	retrieving facility/ Furnish details	
13	Temperature compensation provide or not	
14	Direct reading or use of Multiplication factor required/ If required MF	
15	No. of Digits provided and whether sufficient for 1000 hrs of operation/Furnish details	
16	Whether current coil have continuous overload capacity of 200% for both accuracy and thermal limits	
17	Whether current coil shall withstand at least 10 times the rated current for o.5 second with out loss of accuracy	
18	Transmitting contacts available or not. Impulse rate/ whether suitable for remote indicating or summation/Furnish details	
19	Communication port/ protocol/ data transfer rate Whether conforming to tender spec. Furnish details.	
20	Whether DLMS compliant	
21	Whether Load Survey feature incorporated.	
Q	**MULTI FUNCTION TRANSDUCERS**	
1	Make	
2	Model No. & Type (3Ph, 3 Element, 4wire)	
3	Whether Programmable	
4	Accuracy	
5	CT Ratio	
6	PT Ratio	
7	Type of Communication port and protocol	
8	Aux DC	

R	RELAYS	
R.1	NUMERICAL DISTANCE PROTECTION RELAY (MAIN-1) 220kV FDR	
1	Make	
2	Model No.	
3	Conforming Standard	
4	Rated Frequency /CVT Voltage/Current	
5	Number of zones	
6	Characteristic of the relay on R-X plane	
7	Zero sequence compensation factor	
8	Reach in	
9	**Zone-1**	
10	Resistive	
11	Reactive	
12	**Zone -2**	
13	Resistive	
14	Reactive	
15	**Zone-3**	
16	Resistive	
17	Reactive	
18	**Zone -4**	
19	Resistive	
20	Reactive	
21	Relay characteristic angle	
22	Typical operating time of the relay	
23	No. of Analog input & output	
24	No. of Digital channels input & output	
25	Burden	

26	Maximum permissible continuous current		
27	Maximum permissible continuous current for 1s		
28	Maximum permissible over voltage		
29	Auxiliary DC voltage		
30	Tripping Mode		
31	Whether sufficient number number of high burden trip output contacts are provided for direct CB trip		Yes/No
31	Accuracy in all zones		
32	Communication port	Front port	
		Rear Optical Ethernet port for IEC 61850	
		Redundant Optical port provided or not	
		Rear IRIG-B port for time synch.	
33	Display		
34	Built - in feature offered in the relay		
35	a) Carrier aided scheme		
36	b) Disturbance Recorder		
37	c) SOTF		
38	d) PT fuse failure		
39	e) Power Swing blocking		
40	f) Auto reclose		
41	g) Fault locator with ± 3% accuracy		
42	h) Barker failure		
43	i) Synch. Check		
44	j) Directional O/C and E/F protections		

45	k) O/V, U/V, O/F, U/F protections	
46	l) Broken Condutor detection	
47	m) Parallel line mutual compensation	
48	Type Test Report attached or not	
R.2	**NUMERICAL DISTANCE PROTECTION RELAY (MAIN-2) 220kV FDR**	
1	Make	
2	Model No.	
3	Conforming Standard	
4	Rated Frequency /CVT Voltage/Current	
5	Number of zones	
6	Characteristic of the relay on R-X plane	
7	Zero sequence compensation factor	
8	Reach in	
9	**Zone-1**	
10	Resistive	
11	Reactive	
12	**Zone -2**	
13	Resistive	
14	Reactive	
15	**Zone-3**	
16	Resistive	
17	Reactive	
18	**Zone -4**	
19	Resistive	
20	Reactive	
21	Relay characteristic angle	
22	Typical operating time of the relay	

23	No. of Analog input & output		
24	No. of Digital channels input & output		
25	Burden		
26	Maximum permissible continuous current		
27	Maximum permissible continuous current for 1s		
28	Maximum permissible over voltage		
29	Auxiliary DC voltage		
30	Tripping Mode		
31	Accuracy in all zones		
32	Communication port	Front port	
		Rear Optical Ethernet port for IEC 61850	
		Redundant Optical port provided or not	
		Rear IRIG-B port for time synch.	
33	Display		
34	Built - in feature offered in the relay		
35	a) Carrier aided scheme		
36	b) Disturbance Recorder		
37	c) SOTF		
38	d) PT fuse failure		
39	e) Power Swing blocking		
40	f) Auto reclose		
41	g) Fault locator with ± 3% accuracy		
42	h) Barker failure		

43	i) Synch. Check	
44	j) Directional O/C and E/F protections	
45	k) O/V, U/V, O/F, U/F protections	
46	l) Broken Condutor detection	
47	m)Parallel line mutual compensation	
48	Type Test Report attached or not	
R.3	**Numerical Directional Over current & Earth Fault Relay**	
1)	Maker's Name	
2)	Model No./Name	
3)	No. of Digital Input & Output	
R.4	**Bus PT Selection Relay**	
1	Makers name	
2	Type and Model Name	
3	Operating Voltage (Volts)	
4	Number of normally contacts	N0 / NC /Change Over
5	Operating coil VA burden	
6	Making capacity of contacts	
7	Whether self reset type or hand reset type	
8	Draw out or non-drawout type	
9	Case finish	
R.5	**TC Supervision Relay**	
1	Makers name	
2	Type and Model Name	
3	Aux Voltage (Volts)	
4	Number of normally contacts	N0 / NC /Change Over

5	Operating coil VA burden	
6	Making capacity of contacts	
7	Whether self reset type or hand reset type	
8	Draw out or non-drawout type	
9	Case finish	
R.6	**DC Supply Monitoring Relay**	
1	Makers name	
2	Type and Model Name	
3	Aux Voltage (Volts)	
4	Number of normally contacts	N0 / NC /Change Over
5	Operating coil VA burden	
6	Making capacity of contacts	
7	Whether self reset type or hand reset type	
8	Draw out or non-drawout type	
9	Case finish	
R.7	**Auxiliary Relay**	
1	Makers name	
2	Type and Model Name	
3	Aux Voltage (Volts)	
4	Number of normally contacts	N0 / NC /Change Over
5	Operating coil VA burden	
6	Making capacity of contacts	
7	Whether self reset type or hand reset type	
8	Draw out or non-drawout type	
9	Case finish	

R.8	**High Speed Tripping Relay**	
1	Makers name	
2	Type and Model Name	
3	Aux Voltage (Volts)	
4	Number of normally contacts	N0 / NC /Change Over
5	Operating coil VA burden	
6	Making capacity of contacts	
7	Whether self reset type or hand reset type	
8	Draw out or non-drawout type	
9	Case finish	
R9	**Distance Relay Main I used for 110kV Feeder CRP**	
1	Make/ Model No.	
2	Digital Input/ Output	
R10	**Distance Relay Main II used for 110kV Feeder CRP**	
1	Make/ Model No.	
2	Digital Input/ Output	
R11	**Distance Relay Main I used for 66kV Feeder CRP**	
	Make/ Model No.	
	Digital Input/ Output	
R12	**Distance Relay Main I used for 220kV Feeder CRP**	
1	Make/ Model No.	
2	Digital Input/ Output	
R13	**Distance Relay Main II used for 220kV Feeder CRP**	

1	Make/ Model No.	
2	Digital Input/ Output	
R14	**Differential Relay Main I used for 110/33kV Trfr**	
1	Make/ Model No.	
2	Digital Input/ Output	
3	Whether 2 REF elements available for HV & LV side	
R15	**Differential Relay Main II used for 110/33kV Trfr**	
1	Make/ Model No.	
2	Digital Input/ Output	
3	Whether 2 REF elements available for HV & LV side	
R16	**Differential Relay Main I used for 110/11 kV Trfr**	
1	Make/ Model No.	
2	Digital Input/ Output	
R17	**Differential Relay Main II used for 110/11kV Trfr**	
1	Make/ Model No.	
2	Digital Input/ Output	
R18	**Differential Relay Main I used for 66/11kV Trfr**	
1	Make/ Model No.	
2	Digital Input/ Output	
3	Whether low impedance REF element suitable for Auto Transformers is available	Yes/No
R19	**Differential Relay Main I used for 110/11 kV Trfr**	

1	Make/ Model No.	
2	Digital Input/ Output	
R20	**Differential Relay Main II used for 110/11kV Trfr**	
1	Make/ Model No.	
2	Digital Input/ Output	
R21	**Differential Relay Main I used for 220/110 kV Trfr**	
1	Make/ Model No.	
2	Digital Input/ Output	
R22	**Differential Relay Main II used for 220/ 110kV Transformer**	
1	Make/ Model No.	
2	Digital Input/ Output	
R23	**REF relay**	
1	Make/ Model No.	
2	Model	
3	Variable Stabilising Resistor (Ω, W)	

Name and Address of Bidder