

TECHNICAL SPECIFICATION

SECTION -

CONTROL AND RELAY  
PANELS

# TECHNICAL SPECIFICATION FOR CONTROL AND RELAY PANELS for 110KV, 66KV and 33KV Sub-Stations.

## 1.0 **SCOPE:**

- 1.01 This Technical specification covers design, manufacture, inspection, testing at works and supply of control and Relay panels, annunciation equipments synchronizing trolley and other miscellaneous equipments for **110KV, 66KV and 33KV Sub-Stations** of KPTCL grid.
- 1.02 The equipment should conform in all respects to the relating standards and shall be manufactured to the highest quality of Engineers design and workmanship. The equipment manufactured shall ensure satisfactory and reliable performance throughout service life.
- 1.03 The equipments offered shall be complete in all respects. Any material / component / accessories not specifically stated in this specification but which is otherwise necessary for trouble free operation of the equipment specified in this specification shall be deemed to be included unless excluded expressly. All such components/ accessories shall be supplied at no extra cost.
- 1.04 The design and manufacturing shall be such that the equipment/ components/ accessories of the same type and of identical rating shall be interchangeable. Likewise similar or corresponding parts/ components or accessories thereof shall also be interchangeable.
- 1.05 Wherever and whenever a material or article or component is specified or described by the name of a particular brand or manufacturer or vendor, the specific item mentioned shall be understood as establishing type, function and quality and not as limiting competition. However, tenders are invited to offer other similar equipment's/components/accessories provided they meet with the required standards, design, duties and performance.
- 1.06 All equipments offered shall confirm to type tests and shall also be subjected to acceptance and routine tests in accordance with the requirements stipulated herein. The purchaser reserves the right for conducting any or all of the type tests in accordance with the relevant standards. Such type tests shall be done free of cost. Where type tests have already been conducted the tenderer shall submit copies of the

same along with tender. The type tests certificates should however be not older than Ten (10) years as on the last date of submission of bid.

**a) For equipments manufactured in India:**

- i. The type tests on indigenous equipment for which testing facility is available in India, should have been conducted in any independent laboratories approved by the Government or the laboratories accredited by the National accreditation body of the country like Central Power Research Institute (CPRI), Electrical Research and Development Association (ERDA), etc.
- ii. The type tests on indigenous equipment, for which testing facility is not available in India, should have been conducted in a laboratory of foreign country accredited by National accreditation body of that country.
- iii. The type tests conducted in-house by a manufacturer shall also be acceptable provided the laboratory is accredited by National accreditation body of the country and the tests has been conducted in the presence of a representative of NABL accredited laboratory or any of the purchasing utilities or CEA in that order. Such type test reports shall record the details of such witness including the signature/authentication in the type test report.

**b) For equipments manufactured Abroad:**

- i. Type tests on imported equipment should have been conducted in an Indian Laboratory or foreign laboratory accredited by National accreditation body of the country where the Type test has been conducted.
- ii. The type tests conducted in-house by a manufacturer shall also be acceptable provided the laboratory is accredited by National accreditation body of the country and the tests has been conducted in the presence of a representative of accredited laboratory or any of the purchasing utilities or CEA in that order. Such type test reports shall record the details of such witness including the signature/authentication in the type test report.

In case of in-house type tested imported equipment of foreign OEM, the term “Purchasing Utility” covers the foreign Utility who has purchased that equipment

**2.00 BRIEF DESCRIPTION OF PROJECT:**

2.01 The details of the project are as per Annexure enclosed.

2.02 The protection to be provided for various lines, transformers etc shall be as follows:

- i. Main protection i.e. distance scheme and differential scheme shall be of fast acting numerical type.
- ii. Back up protection shall be of numerical type.

2.03 There may be changes in components ordered as per order and as per approved drawing. However, subsequent inspection and supply of panels shall confirm to the approved drawing.

### 3.00 **STANDARDS:**

Unless specified otherwise, equipment covered by this specification shall confirm to the Indian Electricity Rules and to the latest editions of relevant Indian Standards. British or American or other equivalent standard. In the event of supplies confirming to other equivalent international standards. The salient features of comparison shall be brought out in the tender. One copy of such standard specification in English Language shall be enclosed with the tender. A general reference list of standards is furnished as follows:

Sl No	Particulars	IS	BS	IFC
1	Application guide for electrical relays for protection and other relays	3842	142	50
2	Electrical relays for power system	3231	----	60255-Part 1 to 23
3	Current transformers	2705	----	----
4	Voltage transformers	3156	----	----
5	Push buttons and control switches (LV switching devices for control and auxiliary circuits)	6875	----	----
6	AC electricity meter	722	----	----
7	Static protective meter	8686	----	----
8	Indicating instrument & recorders	----	89/90	----
9	Fuses	2203	88	66
10	AC static watt hour meter for active energy	----	---	686
11	Colours for ready mixed paints and enamels	5	----	---
12	Ready mixed paints,	127	----	----

	brushing, finishing exterior, and semi glass for general purpose white			
13	Paints, finishing interior white	641	----	----
14	Direct acting indicating analogue electrical measuring instruments and their accessories	1258 part : 1-5 7-9	----	----
15	Degree of protection provided by enclosures for low voltage switch gear and control gear.	2447	----	-----
16	Performance tests for protective scheme used in protection of light gauge steel against corrosion	4777	----	----
17	Communication protocol	----	----	60870-5-101/104
18	Numerical relay	----	----	61000
19	Sub-station automation	----	----	61850
20	Environmental testing	----	----	68
21	Insulation co-ordination for equipment with low voltage system	----	----	664

#### 4.00 CLIMATIC AND GEOGRAPHICAL CONDITIONS:

##### 4.01

Sl No.	Particulars	
1	Altitude	No exceeding 1000Mtrs.
2	a)Max.ambient air temperature	50 deg.C
	b) Average daily ambient air temperature	35 deg.C
3	Minimum ambient air temperature	5 deg.C
4	Relative humidity	10-100%
5	Average annual rainfall	1000 to 3000 mm/5000mm
6	Average period of rainfall in a year	5 months
7	Maximum wind pressure in Kg/Sq.mt	150
8	Isoceraunic level	46

- 4.02 The climate is moderately hot, tropical climate conducive to rust and fungus growth.
- 4.03 The climatic conditions are given to indicate wide range of variation in ambient conditions.
- 4.04 All electrical devices shall be tropicalized and given fungicidal treatment. They shall also be capable of satisfactory operation under the hot and humid climatic conditions that would prevail at the site.
- 4.05 All the equipment's, contacts, etc., shall be designed to withstand seismic acceleration equivalent 0.3 g. Air conditioning is not available in the control room.

## 5.00 **SYSTEM DETAILS:**

5.01 Following is salient particulars of the system.

Sl No.	Particulars	110KV	66 KV	33 KV
1	Nominal system voltage(KV)	110	66	33
2	Highest system voltage(KV)	123	72.5	36
3	No. of phases	3	3	3
4	Frequency ( Hz)	50	50	50
5	Method of grounding	Effectively earthed.	Effectively earthed.	Effectively earthed.

- 5.02 The relays and meters shall be suitable for operation at 1 Amp Current Transformer secondary and 110 V phase to phase and 63.5 volts phase to neutral, secondary voltage of the Voltage Transformer.

## 6.00 **AUXILIARY SUPPLY:**

- 6.01 The Purchaser shall make separate arrangement for providing low tension AC & DC power supply for control and auxiliary use. The bidder shall give in his tender the estimate for AC & DC power required for the equipment covered by this specification.

- 6.02 The auxiliary supply voltage available is as follows:

Sl No.	Particulars	Details
1	Power devices(	415 V, 3 phase 4 wire, 50 Hz grounded AC

	like drive motors etc)	supply.
2	AC control and protective devices	240 V, 1 phase 2 wire, 50 Hz AC supply with one point grounded.
3	DC for alarm, control and protection devices	110 V, 2 wire ungrounded DC supply from batteries and battery charger. The ripple content in the DC supply from the charger will be less than 2%.

The above supply voltage may vary follows:

1	AC supply	Voltage variation +10% to -30% Frequency variation $\pm 5\%$ Both variations may occur simultaneously or independently.
2	DC supply	+10% to -20%.

- 6.03 Each of the foregoing supplies will be made available by purchaser at one terminal point for each equipment for operation of accessories and auxiliary, equipments. In case of 110 V, AC supply is required, the bidder shall include adequately rated 415/ 110 V control transformers for each equipment. Bidders scope of supply shall include distribution beyond the points of supply, including supply of interconnecting cables between instruments and terminal blocks.

## **7.00 TYPE OF PANEL:**

### 7.01 VOID

- 7.02 SIMPLEX PANEL (For panels of 110KV, 66KV & 33KV sub-stations):  
Simplex panel shall consist of a vertical front panel with equipment mounted thereon and having wiring access from rear. In case of panel having width more than 800mm, double leaf – doors shall be provided with pad – lock.

## **8.00 CONSTRUCTIONAL FEATURES:**

- 8.01 Control & Relay Board shall be of panels of simplex design, It is the responsibility of the bidder to ensure that the equipments specified and such unspecified complementary equipment required for completeness of the protective/ control schemes be properly accommodated in the panels without congestion mid if necessary, provide panels with larger

dimensions. No price increase at a later date on this account shall be allowed.

- 8.02 Panels shall be completely metal enclosed and shall be dust moisture and vermin proof. The enclosure shall provide a degree of protection not less than IP-31 in accordance with IS : 2147.
- 8.03 Panels shall be free standing, floor mounting type and shall comprise structural frames completely enclosed with specially selected smooth finished. Cold rolled steel of thickness not less than 3 mm for weight bearing members of the panels such as base frame, sheet and door frames, and 2.0 mm for sides, door, top and bottom portions. There shall be sufficient reinforcement to provide level, surfaces, and resistance to vibration and rigidity during transportation and installation.

The dimensions of the control and relay panels shall be as given below:

Height -2312 mm including base channel height of 102 mm.

Depth - 610

Width - 700/ 1000 mm.

- 8.04 All doors removable covers and panels shall be gasketed all around with neoprene gaskets. Ventilating louvers if provided shall have screens and filters. The screens shall be made of either brass or GI wire mesh.
- 8.05 Design, materials selection and workmanship shall be such as to result in neat appearance, inside and outside with no welds, rivets or bolt heads appearing from outside, with all exterior surfaces smooth.
- 8.06 Panels shall have base frame with smooth bearing surface, which shall be fixed on the embedded foundation channels/insert plates. Anti-vibration strips made of shock absorbing materials, which shall be supplied by the bidder, shall be placed between panels & base frame.
- 8.07 Cable entries to the panels shall be from the bottom. Cable gland plate fitted on the bottom of the panel shall be connected to earthing of the panel/ station through a flexible braided copper conductor rigidly.
- 8.08 Relay panels of modern modular construction would also be acceptable.
- 8.09 The purchaser reserves the right to order the panels in full or part of the quantity indicated in the annexure. However, the breakup will be station – wise.



8.10 The offer shall include dummy panels and filler plates wherever necessary to have continuous formation. However the purchaser reserves the right to order the dummy panels and filler plates.

**9.00 MOUNTING:**

9.01 All equipment on and in panels shall be mounted and completely wired to the terminal blocks ready for external connections. The equipment on front of panels shall be mounted flush with only their bezels projection.

9.02 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. Terminal marking on the equipment shall be clearly visible.

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

9.04 The centre lines of switches, push buttons and indicating lamps shall be matched to give a neat and uniform appearance. Like wise the top lines of all meters, relays and recorders etc., shall be matched. The control switches of breakers and isolators shall be located on the mimic diagram corresponding to the exact of the control equipment in the single line diagram.

9.05 Final arrangement of control instruments & relays shall be as per the drawing approved by the purchaser.

9.06 No equipment shall be mounted on the doors.

9.07 At existing station, panels shall be matched with other panels in the control room in respect of dimensions, colour, appearance and arrangement of equipment (center lines of switches, push buttons and other equipment) on the front of the panel.

9.08 All the equipment connections and cabling shall be designed and arranged to minimize the risk of fire and damage which may be caused by fire.

9.09 If any cutouts are left blank for mounting of future equipment, it shall be properly blanked off with metal plates, and wires left shall be properly insulated or terminated to a terminal block.

**10.00 PAINTING:**

- 10.01 All sheet steel work shall be phosphated in accordance with the IS: 6005 "Code of practice for phosphating iron and steel"
- 10.02 Sheet steel shall be sand blasted to remove rust and scale, oil grease, dirt and swarf shall be thoroughly removed by emulsion cleaning.
- 10.03 Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with a slightly alkaline hotwater and drying.
- 10.04 After phosphating through rinsing shall be can-ied out with clean water followed by final rinsing with dilute dichromate solution and oven drying.
- 10.05 The phosphate coating shall be sealed with application of two coats of ready mixed, stoved type zinc chromate primer. The first coat may be flash dried while second coat shall be stoved.
- 10.06 The panel exterior shall finally be painted with two coats of synthetic enamel paint, each coat applied by stoving. The colour of the finishing paint shall generally be "opaline green" corresponding to shade No.275 of IS-5 for panel exterior. All cubicle interiors shall be painted white, so as to give a contrasting effect with cubicle wiring
- 10.07 Each coat of primer and finished paint shall be of slightly different shade to enable inspection of painting. The final finished thickness of paint film shall not be less than 60 microns and shall not be more than 100 microns.
- 10.08 The finished paint appearance shall be aesthetically pleasing and shall be free from scratches, dents or unevenness. A small quantity of paintshall be supplied free of cost for minor touching up, if nay that may be required at site.
- 10.09 In case the bidder proposes to follow any other established painting procedure like electrostatic painting, the procedure shall be submitted along with offer/bid for purchaser's review and approval.
- 11.00 **WIRING:**
- 11.01 All wiring shall be of board type super flexible multi-stranded, tinned, annealed copper wire with suitable PVC insulation, FRLS type, of 1.1 kV grade conforming to IS-694 which has proved its utility in tropical regions against hot and moist climate and vermin (mice, white ants and cockroaches, etc.).
- 11.02 The size of wiring in different circuits shall not be less than those specified below:

Sl No	Circuits	Area of cross-section of conductor ( minimum permissible size of wire)
1	Metering and relaying circuits connected to CTs and PTs	2.5 sq. mm
2	Audio visual annunciation, signaling and control circuits	2.5 sq. mm
3	AC/DC Auxiliary control supply circuits	2.5 sq. mm

11.03 Following colour scheme shall be used for the wiring.

Colour of the wire	Circuit where used	Colour of the ferrule
Red	Red phase of instrument transformer circuit	Red
Yellow	Yellow phase of instrument transformer circuit	Yellow
Blue	Blue phase of instrument transformer circuit	Blue
Green	Neutral connections earthed or not earthed in the instrument transformer circuits	Green
White	AC control wiring circuits using 415/ 240 V auxiliary supply and cubicle lighting	Respective phase: Red, Yellow and blue Neutral : green
Grey	DC control wiring circuits using 110 V DC battery	Red : Trip circuit Blue : indicating circuit Yellow: alarm circuit Green : relay, auxiliary and other inter-connections
	Lower voltage DC supply (from DC to DC converter)	

11.04 All cubicle wiring shall be of the grouped type and laid out in flat formation on the framework, in the interior of the panel cubicles and secured to it by means of cleats. Wiring shall be run straight and given right angle bends wherever necessary. Wiring round the hinges shall be of extra flexible conductors twisted around the axis of the wires.

Longitudinal through extending throughout the full length of the panel shall be preferred for the intern panel wiring. Interconnection to adjacent panels shall be brought out to a separate set of terminal blocks located near the slot of holes meant for taking the interconnecting wires. All potential bus wiring, audible alarm, bus

wiring, AC & DC control supply bus wiring, wiring for cubicle lighting and such other wiring which runs from cubicle to cubicle within the switchboard shall be laid down in gutters and shall be carefully screened.

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

Each wire shall be continuous from end to end and shall not have any joints within itself. Individual wires shall be connected only at the connection terminal or studs of the terminal blocks, meters, relays, instruments and other switch board devices.

Terminal ends of the wires shall be provided with numbered self-locking ferrules suitably coloured for phase identification. At points of intersection where a change of number is necessary, duplicate ferrule shall be provided with the appropriate number on the changing end.

Wire ends shall be elegantly hooked with Ross - Courtney solderless Terminals. At the terminal connection, washers shall be interposed between wire terminals and the holding nuts. All holding nuts shall be secured with locking nuts. The connection stud shall project at least 3 mm from the lock nut surface,

Wiring shall be so connected at the terminal studs that no wire terminal number ferrule gets masked due to succeeding connections. All wire shall be suitable for bending and shall meet the terminal studs at right angles with the stud axis and they shall not be skewed.

All studs, nuts, bolts, screws etc., shall be threaded according to the IS practice unless purchaser's approval to any practice of threading is obtained. Spare quantity of nuts, lock nuts and washers of all varieties used on the switchboard shall be supplied to the extent of 10% of the used quantities. The supplier should note that there would be no mezzanine floor for the control room building for cable spreading and the method of taking the cables directly into panel from the duct shall be clearly indicated.

Contractor shall be solely responsible for completeness and correctness of the internal wiring and for the proper functioning of the connected equipments.

## **12.00 TERMINAL BLOCKS AND TERMINAL CONNECTORS:**

- 12.01 Terminal blocks shall be of the projecting stud type with check nuts and washes. The insulation housing of the terminal connector along with barriers shall be moulded form thermosetting resin dielectric and shall be of AC 1100 V grade. The stubs shall be fully threaded and shall be of tin plated brass. The size of the stubs shall be suitable for a continuous rating of not less than 35 Amps and shall accommodate the conductor terminal with a close fit. Check nuts and washers shall also be of tin plated brass. Check nut shall be hexagonal and shall be suitable for being tightened with tubular box type spanners. The end termination facility shall be suitable for tightening with screw driver. Tin plated brass inserts shall be provided between the terminal connector studs for effective resistance free, electrical contact between the incoming and outgoing terminations.
- 12.02 Terminal connectors shall be preferably of bolts nut type for being assembled on to standard mounting channels for multiway grouping form terminal blocks. These terminal blocks shall be mounted vertically in columns inside the panel in a pillar type formation and shall be so located that the incoming tail ends of the control cables can be terminated to these terminal blocks easily.
- 12.03 All terminal blocks shall be provided with removable shrouds made of transparent dielectric material rated for 11000 grades. Each shroud shall be etched or provided with a plastic marker strip to identify the circuits that are terminated.
- 12.04 Each terminal block shall be provided with at least 30% spare terminals on each panel and these spare terminal shall be uniformly distributed on all terminal blocks.
- 12.05 All stubs, nut, screws etc., shall be threaded according to IS:7684. Sufficient spare quantities of all varieties and size of bolts, studs, nuts, washers and screws used in the cubicle shall be supplied along with cubicle free of cost.
- 12.06 Where terminal blocks are arranged in different columns or rows then minimum clearance of 150 mm shall be provided between the terminal block. A minimum clearance of 250 mm shall be kept between Terminal blocks and associated cable gland plates.
- 12.07 Terminal blocks containing CT secondary leads shall be provided with test, isolating, short circuiting facilities/ sliding link type and VT's secondary leads provided with isolating features.

- 12.08 Arrangement of terminal block assemblies and wiring channel within the enclosure shall be such that a row of terminal blocks is run in parallel and close proximity along each side of the wiring duct to provide for convenient attachment of internal panel wiring. The side of terminal block opposite to wiring duct shall be reserved for the owner's external cable connections. All the adjacent terminal blocks shall also share the field wiring corridor. All the wiring shall be provided with adequate support inside the panels to hold them firmly and to enable free and flexible termination without causing strain on terminals.

### **13.00 SPACE FOR CONTROL CABLES AND CABLE GLANDS:**

All control and supply cable will be conducted at the bottom of the cubicles. The bottom plates of panels shall be fitted with removable gland plates and fixed with the cable glands, the size of which shall suit the owner's external cables. Cable glands shall be screened type and made of brass or nickel-plated steel and shall be suitable for PVC unarmoured cable. Necessary drawing showing the cable entry position and foundation bolt location shall be supplied by the bidder. The required quantities of cable glands suitable for the cable sizes as described below shall be provided in each panel.

**19 C x 2.5 Sq. mm for Power Transformer.**  
**19 C x 2.5 Sq. mm for Circuit Breaker.**  
**10 C x 2.5 Sq. mm for Circuit Breaker.**  
**4 C x 6.0 Sq. mm for CT Circuits.**  
**2 C x 10 Sq. mm for NCT Circuits.**  
**4 C x 6 Sq. mm for PT Circuits.**  
**10 C x 2.5 Sq. mm for Isolator.**  
**2 C x 2.5 Sq. mm. for coupling capacitor.**

### **14.00 MIMIC DIAGRAM:**

- 14.01 Each control panel shall be provided on the front face of the panel with a mimic bus of the system and of the circuit to which the panel refer-to. The width of the mimic bus shall not be less than 10 mm. The mimic bus shall represent the single line diagram of the system and indicate the relative position of each equipment in the run of the mimic bus. Corresponding control switches shall be mounted along the mimic diagram at appropriate location.
- 14.02 The mimic. bus shall be of the anodized aluminum strip type: with distinguished colours to differentiate between different voltages.

### **COLOUR SCHEME FOR MIMIC DIAGRAM:**

Voltage class for new stations	Colour	Shade index as per IS 5
110KV	Dark brown	412
66KV	Canary yellow	309
33KV	Brilliant green	221
11KV	Signal red	537
415 V	Violet	796
Earth	Black	----

In case of extension panels, the colour of the mimic should match with the existing colour of the mimic, which will be furnished.

- 14.03 Mimic diagrams shall be incorporated with colour lamp indicators for indicating isolating switch position, circuit breakers status indication and also flash type lamp for auto trip shall be provided for the breaker.

## **15.00 NAME PLATE & MARKINGS**

- 15.01 Each unit control and relay panels shall be provided with a circuit label of size 40 mm x 200 mm (min) located prominently at the top on the front and rear face of the duplex panel. Circuit labels shall be located inside the cubicle also for easy identification on both halves of the panel. These nameplates and labels shall bear the name of the circuit or equipment etc, to which the panel is associated with. The letter shall have a minimum height of 20 mm.
- 15.02 The name plate shall be 50 mm width plates made of brass or block plastic and shall be etched with 3 mm sized letters of the name of the associated circuit / equipment. The etched letters shall be duly filled in with white enamel paint, if the plate is of black plastic or with black enamel if the plate is of brass.
- 15.03 All instruments, relays and such other electrical devices and accessories mounted in the control panel shall be provided with name plate bearing the name of the manufacturer, serial number, type and technical rating data. These nameplates shall be installed at the rear of the device inside the cubicle.
- 15.04 All instruments and control switches shall bear clear inscription identifying its function eg, BREAKER, AMMETER, etc., similar inscription shall also be provided on each device whose functions not otherwise identified. If any switch device does not bear this inscription, separate nameplate giving its function shall be provided for it. Switch shall also have clear inscription for each position indicating eg. "Trip-

Neutral-Close", "ON-OFF, "R-Y-B-OFF" etc. Where equipment has ASA code number such as for relays, CBs etc., the identity, plate shall bear this number with appropriate prefixes and suffixes in addition to the function name. The ASA code numbers shall be the same as the one indicated by the bidder in the detailed wiring diagram.

15.05 Each panel shall be provided with a label located at the bottom corner on the front shall contain the following details:

- i. Manufacturer's name.
- ii. P.O. No. & date.
- iii. Drawings reference No. that pertains to that panel.
- iv. Serial No. of the panel.

The letters on nameplates shall have minimum height 4 mm and the gap between lines / words shall be more than 2 mm.

## **16.00 INTERNALLY MOUNTED EQUIPMENTS:**

### **16.01 SPACE HEATERS:**

Each control and relay panel shall be provided with a strip type or coil type tubular enclosed space heaters to prevent condensation of moisture within the panel. It shall be installed at the base of the cubicle and operated on 240 V AC single phase supply. The surface temperature shall be well below visible heat. Space heaters shall be provided with an independent switch control, fuse and an adjustable thermostat to regulate the temperature.

### **16.02 PANEL LIGHTING:**

The interior of the cubicles shall be illuminated by fluorescent lamps. The illumination shall be free from hard shadows and shall be planned to avoid any strain or fatigue to a wire man working inside the cubicle due to any abnormal or non-uniform illumination. These lamps shall be operated through switches or door push buttons. It shall operate on 240 V, AC single phase supply.

### **16.03 POWER SOCKETS:**

At least 3 nos. of 5 Amps three pin multiple plug points and 2 nos. of 15 Amps 3 pin power plug outlets shall be provided at convenient points in



each set of the 110 kV, 66 kV and 33kV control panels. The plug points shall be provided with electrical and mechanical cover with chain.

## **17.0 FUSES:**

- 17.01 H.R.C. fuses of adequate current and voltage rating shall be provided inside the cubicle for the various protection, control and incoming auxiliary, AC & DC supply circuits.

The fuse bases and carriers shall be mounted inside the cubicle in an easily accessible location. They shall conform to relevant standard and shall be designed to carry HRC cartridge fuse links. The fuse bases and carriers shall be moulded from the thermosetting resin dielectric or moulded standard grades phonemic Bakelite or equivalent thereof and shall be black in colour. The selection of the main and sub-circuit fuse ratings shall be such as to ensure selective clearance of sub-circuits faults. ALL accessible live connections to fuse bases shall be adequately shrouded. Fuses shall have operation indicators for indicating blown fuse condition. Fuse carriers and bases shall have imprints of the fuse rating and voltages.

There shall be individual fuse units for each of the following circuits:

- i) Signaling and Annunciation circuits.
- ii) V.T. secondary instrument circuits.
- iii) V.T. secondary, relay circuits.
- iv) AC & DC control circuits (shall be separate for CB & Isolators).
- v) AC auxiliary circuits.
- vi) AC Power socket, cubicle space heater and lighting.
- vii) Others if any.

## **18.00 EARTHING:**

- 18.01 All panels shall be provided with a bare copper tinned earthing bus extended throughout the length of the panel. The size of the earthing bus shall not be less than 25 mm x 6 mm, when several panels are mounted adjoining each other, the earth bus shall be made continuous and necessary connection and clamps for this purpose shall be included in the scope of supply. Provision shall be made for extending the earth bus bars at a future date into now adjacent panels to be installed if any.

Provision shall be made at the end panels for connecting the same to the system earth ground mat.

- 18.02 All metallic of instruments, relays, accessories installed within the cubicle shall be connected to the earth bus with 1100 V grade standard multicore 2.5 sq. mm PVC insulated conductor of green colour. The rim of the wires shall be continuous without any joints shall be crimped at either end with open type solderless lugs.
- 18.03 Looping of earth connections, which would result in loss of earth connection to other devices when the loop is broken, shall not be permitted. However, looping of earth connections between equipment to provide alternative paths to earth bus shall be provided.
- 18.04 VT & CT secondary neutral or common lead shall be earthed at. One place only at the terminal blocks where they enter the panel such earthing shall be made through links so that earthing may be removed from one group without disturbing continuity of earthing system for other groups.

#### **19.00 INDICATING LAMPS:**

- 19.01 Indicating lamp shall be integral LED module type, 0.7 watts suitable for 110 V DC supply / 240 V AC for DC fail indication, as the case may be and these shall be integral, self contained LED indicator -units which can be directly mounted on the panel. The rated input voltage can be directly applied to module input, as all the controlling circuitry is built in to the module body itself. These modules shall be suitable for panel, cutouts of size 22.5 mm dia with the use of chrome plated standard mounting bezel/ adopter sets. The axial light intensity should be minimum 40-milli candela.
- 19.02 LED lamp shall be interchangeable and easily replaceable from the front of the panel. Tools if required for replacing the LED lamps also be included in the scope of supply.
- 19.03 The indicating lamps shall withstand 120% of rated voltage on a continuous basis.
- 19.04 The colour scheme of the signal lamps shall be as follows:

Signal for	Indicating by light
CB closed	Red
CB open	Green
CB auto trip	Amber*

Isolator closed	Red
Isolator open	Green
CB spring charging indication	Blue
PT phases / trip circuit supervision	White

\* CB - Auto trip to indicate abnormal conditions requiring action such as discrepancy in operation of protection circuits of alarm circuits.

- 19.05 In the initial supply, 25% of the lamp actually used on the switch board shall be supplied in excess to serve as spares.

## **20.00 TEST TERMINAL BLOCKS:**

- 20.01 Each control panel where metering is involved shall be installed with instrument test terminal blocks. These test terminal blocks shall be designed for use on panels with poly-phase meters to facilitate their in-situ testing. The test terminal blocks shall be mounted at the bottom end of the front face of the panel. They shall be of the projecting type semi-flush mounted with wire connected at the back. All wiring to indicating integrating and recording instruments shall be done through the Test Terminal Block. The test terminal block shall be provided with screw type front cover such that the removal of this cover shall grant access to the terminals in front for connecting check meters or for injection of external supply to the instruments.
- 20.02 The test terminal blocks shall facilitate in-situ testing of instruments without interrupting the primary load circuit. The current terminals shall therefore be provided with shorting arrangement through links before interrupting the normal circuit for insertion of external check meters or for injection of art external supply into the panel instruments without causing an open circuit in the current transformer secondaries. The potential terminal shall be provided with sliding links for isolation of the normal supply voltage to the panel instruments from the secondaries of voltage transformer.
- 20.03 The test terminal block shall have its insulation housing made of a moulded dielectric material such as phonolic Bakelite or equivalent thereof with adequate insulation between current and potential terminals of different phases, The potential testing studs shall preferably be housed in narrow recesses of the block-moulded insulation to prevent accidental short circuit between potential studs themselves or between potential and current terminals. The cover studs to be provided shall be suitable for sealing with lead seals so as prevent unauthorized access to the test studs.

- 20.04 The test terminal block rating shall be 1100 volts, 35 Amps, The terminals shall be nickel-plated brass and their contact resistance shall be less than 1 milli ohm. The test Terminal Block shall preferably be of IMP make or any other standard link type makes.

## **21.00 CONTROL SWITCHES:**

- 21.01 Control and instrument switches shall be rotary operated type, with escutcheon plate clearly marked to show operating position and circuit designation plates and suitable for flush mounting with only switch front plate and operating handle projecting out. Handles of different shapes and suitable inscriptions on switches shall be provided as an aid to switch identifications.

- 21.02 The selection of operating handles for the different types of switches shall be as follows;

Breaker, isolator control switches	Pistol grip, black
Synchronizing switches	Oval, black, keyed handles ( one common removable handle for a group of synchronizing switches or locking facility having common key)
Selector switches	Oval or knob, black
Instrument switches	Round, knurled, black
Trip transfer switches	Pistol grip, lockable, black

- 21.03 The control switch of breaker and isolator shall be of spring return to neutral type. The spring return type shall be provided, with lost motion device and minimum ten ways for CB control switch and four ways of isolator control switch. The control springs shall be strong and robust enough to prevent inadvertent operation due to light touch. The spring return type switch shall have spring return from close and trip positions to "after close" and "after trip" position respectively.
- 21.04 Instrument selection switches shall be of maintained contact (stay put) type. Ammeter selection switches shall have make-before-break type contacts so as to prevent open circuiting of CT secondaries when changing the position of the switch. Voltmeter transfer switches for AC shall be suitable for reading all. Line-to-line and line-to-neutral voltage for non effectively earthed systems and for reading all line to line voltages for effectively earthed system.

21.05 Lockable type switches, which can be locked in particular positions, shall be provided when specified. The key locks shall be fitted on the operating handles.

21.06 All control switches shall be wires connected at the back. The contact mechanism shall become operated. The contacts shall be silver faced and designed for liberal rating of the duty involved. The contacts shall be provided with a dust and vermin proof removable protection cover. The protection cover shall preferably be of transparent, inflammable material made of moulded dielectric material. Springs to be provided in the switch shall not be used as current carrying parts. The contacts provided in the switch shall not be used continuous current carrying parts.

The contact combination and their operation shall be such as to give completeness to the interlock and function of the scheme. The contact rating of the switches shall be as follows :

	Contact rating in Amps	
	220/110 V DC	240 V AC
Make and carry continuously	10	10
Make and carry for 0.5 seconds	30	30
Break:		
1. resistive load	3	7
2. inductive load with L/R = 40 ms	0.2	---

21.07 The isolator shall have electrical interlock, so that isolator can't be opened or closed if the CB is in closed position, If any attempt is made there shall be an audible and visual alarm.

## **22.00 VOID**

## **23.00 PUSH BUTTON SWITCHES**

- a) Push button switches provided, shall be of the momentary contact type wired back connected. They shall be semi-flush mounted and where required they shall be shrouded to prevent inadvertent or undesirable operation. They shall be provided with integral inscription plates engraved with their functions.
- b) All push buttons shall be with two sets of Normally Open (NO) and Normally Closed (NC) contacts. The contact faces shall be silver plated. and shall be able to make/break and carry the rated current. The rated current shall be appropriate to the duty of the desired function, but not less than 5 Amps.

## 24.00 VOID

## 25.00 ANNUNCIATION SYSTEM:

- 25.01 Separate Alarm annunciation system shall be provided for each control panel by means of visual and audible alarm in order to draw the attention of the operator to the abnormal operating conditions of the operation of some protective devices. The annunciation equipment shall be suitable for operation on the voltage specified.
- 25.02 The annunciation shall be of visual and audible type. The visual annunciation shall be provided by annunciation facia, mounted Rush on the top of the control panels. The audible alarm shall be provided by alarm buzzer or bell.
- 25.03 The annunciator facia shall be provided with translucent plastic window for alarm point with minimum size 35 mm x 50 mm. The facia plates shall be engraved in black lettering with respective inscriptions, which will be approved by the Employer. Alarm inscriptions shall be engraved on each window in not more than three lines and size of the lettering shall not be less than 5 mm. At the existing sub-station's control rooms, annunciation scheme shall be engineered as an extension to the existing scheme.
- 25.04 Each annunciation window shall be provided with two white lamps in parallel to provide safety against lamp failure. Long life lamps shall be used. The lamp circuit shall include series resistor of adequate rating. The cover plate of the facia windows shall be flush with the panel and shall be capable of easy removal to facilitate replacement of lamps. The transparency of cover plates mid wattage of the lamps provided in the facia windows shall be adequate to ensure clear visibihtlv of the inscriptions iii the control room having high illumination intensity (500 Lux) from the location of the Operator's desk.
- 25.05 TRIP & NONTRIP facia shall be differentiated. All TRIP facia. shall have red colour and all NONTRIP facia shall have white colour.
- 25.06 Sequence of operation of the annunciator shall be as fallows:

Sl No	Alarm condition	Fault contact	Visual annunciation	Audible annunciatio n
1	Normal	Open	OFF	OFF
2	Abnormal	Close	Flashing	ON

3	Accept push button is pressed	a) close b) open	Steady ON Steady ON	OFF OFF
4	Reset push button is pressed	a) close b) open	ON OFF	OFF OFF
5	Lamp test push button is pressed	open	Steady ON	OFF

25.07 Visual and audible annunciation for the failure of DC supply to the annunciation system shall also be provided and this annunciation shall operate on 240 V AC supply with separate fuses. On failure of the power supply to the annunciation system for more than 2 or 3 secs (Adjustable setting) a facia shall light up and bell shall sound. A separate push button shall be provided for the cancellation of this audible alarm alone but the facia window shall remain steadily lighted till the supply to the annunciation system is restored. The sound of the audible alarm (bell) provided for this annunciation shall be different from the audible alarm provided for the annunciation system.

25.08 A separate voltage check relay shall be provided to monitor the failure of supply (240 V AC) to the scheme mentioned in the above Clause. If the failure of supply exists for more than 2 to 3 secs, this relay shall initiate visual and audible annunciation.

The annunciation system described above shall meet the following additional requirements:

- a) The annunciation system shall be capable of catering to at least 24 simultaneous signals at a time.
- b) One self-resetting push button shall be provided on each panel for testing the facia window lamps. Push buttons for testing flasher and audible alarm circuit of annunciation system and for the testing the annunciation supply failure monitoring circuit shall be provided. These testing circuits shall be so connected that while test is being done it shall not prevent the registering of any new annunciation that may land during the test.
- c) One set each of the following push buttons shall be provided on each panel.
  - i) Reset push button for annunciation system.
  - ii) Accept push button for annunciation system,

- d) The annunciation shall be repetitive type and shall be capable of registering the fleeting signal. Minimum duration of the fleeting signal registered by the system shall be 5 milli secs.
  - e) Auxiliary relay for annunciation system shall have adequate auxiliary potential free contacts for use in event logger.
  - f) The annunciation shall be suitable for an operation with normally open fault contacts. Which close on a fault. For fault contacts which open on a fault, it shall be possible at site to change annunciators from "close to fault" to "open to fault" and vice versa.
  - g) The annunciation relays shall be electro-magnetic type and should not get affected by spurious external signals and should give trouble free service in hostile atmosphere encountered in sub-stations like switching of EHV breaker, Isolator etc.
  - h) The annunciation system to be supplied for the existing substations have to be matched with the existing scheme in coordination with the purchaser during detail engineering stage.
- 25.09 One set of bell, hooter shall be provided for each group of 110kV, 66 kV & 33 kV line / transformer panels. Each of these sets of bell and hooter can be provided in any one of the line/bus coupler panel of respective groups. The bell and buzzer shall have clear resounding ringing tone audible at the far end of the control room or the station. Suitable hand reset relay devices shall be provided for the bell and buzzer circuits to allow for manual cancellation of the audible alarm in token of its acceptance by an operator before rectification of the abnormally can be made. The wiring shall be such that one set of bell and alarm cancellation relay shall be sufficient and serve in common with all the associated alarm actuating devices caused by tripping of the equipment/breakers. For each group of 110 kV, 66 kV & 33 kV line / transformer panel. Similarly there shall be one set of buzzer and alarm cancellation relay or each group to serve in common with all the alarm actuating devices which do not cause tripping of the equipment/breakers for each group of 110 kV, 66 kV & 33 kV line / transformer panel.
- 25.10 The number of facia windows required is indicated in the schedule of annunciator windows in Annexure. The facia details of windows to be connected to trip circuitry and non-trip circuitry will be furnished to the successful bidder.

## **26.00 INDICATING & INTEGRATING INSTRUMENTS:**

### **26.01 GENERAL REQUIREMENTS:**



- a) All indicating and integrating instruments shall be of the switchboard type, wired back connected and semi flush mounted, with only the instrument bezels projecting on the front face.
- b) The instrument dials shall be fully tropicalised and shall be of such materials as to ensure freedom from war-ping fading or discoloration. All scale markings shall be in black on white instrument dial background. Knife edge pointers and parallax free dials are preferred.
- c) All instruments shall be provided with dust tight cases. All nuts, screws and threaded parts shall preferably conform to relevant standards and all indicating instruments to IS - 1248 or relevant standards.
- d) The indicating instruments shall have an accuracy class 1.0 or better. The design of the scales shall be such as to have a resolution corresponding to 50% of the accuracy class index. The integrating instruments shall have an accuracy class 0.5 or better.
- e) All indicating instruments shall be provided with a front of board zero pointer adjuster capable of being operated safely even when the instrument is in service. The adjustment above and below the zero point shall not be less than 30% and not more than 60% of the full scale reading. The adjuster shall be capable of being rotated through an angle of 360 degree without damage to any part of the instrument and it shall have sufficient friction or spring control to keep the adjustment in position.
- f) All the indicating instruments shall be in conformity with relevant standards. The bidder should note that the instrument security factor of metering CT's is 5 and hence all the meters should withstand 5 times the normal secondary current without any damage.
- g) All circuits of the instruments shall be capable of withstanding applied load of 20% greater than the rated capacity for period of eight hours.
- h) All current and/or voltage coils of meter shall withstand continuously 120% of the rated current/ voltage and 120% thereof for 0.5 seconds without loss of accuracy.
- i) All indicating instruments shall be provided with direct reading double range scales. The scale ranges are indicated in the panel wise schedule of requirements. The ammeter and voltmeter scale ranges are to be zero end suppressed.
- j) Wattmeters, varmeters, watthour meters and varhour meters shall be of the 3 phase, 2 element type suitable for measurement of unbalanced loads in 3 phase circuits. The wattmeter and varmeter scales shall be uniformly graduated with center zero unless specified otherwise to duly indicate Import / Export.

- k) Watthour meters, varhour meters and frequency meters shall be of static type. They shall record and indicate the measured parameters even at low voltage upto -30% of rated operating AC voltages and -20% of auxiliary supply voltages.

#### 26.02 AMMETERS:

AC ammeters shall be moving-iron type 96 sq. mm, zero end suppressed 240 degrees scale with dual range. It shall be suitable for 1 Amp (one Amp) CT secondary and for flush mounting.

#### 26.03 VOLTMETERS:

Void

#### 26.04 MW/MVAR METERS:

Void

#### 26.05 INTEGRATING METERS:

- o It shall be of static type, 3 phase, 4 wire trivector meter suitable for 1 Amp, CT and 110 volts phase to phase VT secondaries.
- o The meter should be of 0.2s accuracy class with ABT & TOD features & DLMS compliant.
- c) The meter shall conform to detail specification enclosed as in ANNEXURE.

#### 26.06 FREQUENCY METER:

Void

#### 26.07 Multifunction Meter:

Microprocessor based, 3 phase 3element 4 wire with accuracy class 0.2, suitable for respective CT ratios of Feeders/Transformers and PT ratio 11kV/ $\sqrt{3}$ /110V/ $\sqrt{3}$  with RS 485 Modbus protocol. It shall display current, Voltage, frequency, power factor, active power, reactive power etc.,

### **27.00 RELAYS:**

#### 27.01 GENERAL EQUIPMENTS:

- a) All relays shall conform to the requirements of IS3231/IEC 50255/IEC 61000 or other applicable standards. Relays shall be suitable for flush or semi flush mounting on the front with connections from the rear.

- b) For numerical relays the scope shall include the following:
  - i) Necessary software & hardware to up/down load the data to/from the relay from/to the personal computer provided in the station.
  - ii) The relay shall have suitable communication facility for connectivity to SCADA/SAS. The relay shall be capable of supporting IEC-61850 protocol.
  - ij). Cyber security: The protection relays & control IED's shall be compliant to NERC standard to ensure security & availability of secured data at remote access.
- c) A detailed note regarding the various quality control procedures adopted by the manufacturer should be given with special reference to static / numerical relay components on their quality assurance tests. Information should be furnished regarding various equipment used for quality assurance tests.
- d) The numerical relays offered must have proven performance. The bidder shall give a detailed account of the field experience of the relays offered, information regarding experience in designing etc.
- e) The protection scheme at the other end of the transmission line will be furnished to the successful bidder if required. The other particulars like distance of the lines, impedance, CT ratios, PT details will be furnished to the successful bidder and should provide the protection schemes suitable for parameters furnished.
- f) The relay codes mentioned in the wiring/ schematic diagram, for auxiliary relays etc., which are part of a composite relay, shall be marked on the name plate provided. This is required to facilitate the field staff, to identify the auxiliary relay provided in the composite unit at the time of trouble shooting.
- g) All relays, other components, wiring etc shall withstand a test voltage of 2.5kV RMS, AC, 50 Hz.
- h) The tenderer shall give a detailed account of the field experience of the relays offered. Information regarding experience within the country should be indicated, giving the approximate quantity of similar relays supplied in India. The bidder should also give an account of his experience in designing coordinating similar protective gear within the country.
- i) The tenderer shall indicate what facilities are available with him within the country for repair / recalibration of the relays offered by him. Whether such facilities are available for the repair of imported relays included in his offer shall also be stated in the tender.

- j) The tenderer shall indicate what facilities are available with him for commissioning these Relays. Such facilities shall cover indigenous and imported equipment. The bidder shall arrange to train at his cost the engineering staff of KPTCL for trouble-free operation and maintenance of these relays.
- 27.02 a) The protective and auxiliary relays offered shall be of proven design and based on sound principles and should conform to BS : 142 and IS : 3231 and IEC : 60255 wherever applicable. The protection equipment shall be designed and applied to provide maximum discrimination between faulty and healthy circuits and its performance shall be in accordance with the BS standard 3950. The equipment shall remain in operation during transient phenomenon, which may arise during switching or other disturbances to the system. They shall be in standard cases and shall be provided with dust and vermin proof cases and covers, The covers shall be transparent and shall be removable from the front. The relay shall be suitable for semi-flush mounting only the flanges projecting in the front and with connection from the rear. The relays shall be rectangular in space and dull black or egg shell black enamel painted cases.
- b) All protective relays shall be in draw-out or plug-in type / modular cases with proper testing facilities. The testing facilities provided on the relays shall be specifically stated in the tender. Necessary test plugs shall be supplied loose and shall be included in bidder's scope of supply. Test block and switches shall be located immediately below each relay for testing. As an alternative to test block and test plug arrangements the bidder shall also quote alternative testing facility of protective relays by providing a push button which when pressed connects the testing equipment to the relay coils and injects current in the coil and automatically disconnects the trip circuits and on operation of relay gives a signal that the equipment and the circuits are correct. The above tests shall be carried out without short circuiting the CT secondary connections. The Purchaser reserves the right for accepting any one of the above two testing facilities. Unless otherwise specified all auxiliary relays and timers shall be supplied in non-draw out cases/ plug-in type modular cases.
- c) All AC relays shall be suitable for operation at 50 Hz AC Voltage operated relays shall be suitable for 110 Volts VT secondaries and current operated relays for 1 Amp CT secondaries as specified. DC auxiliary relays and timers shall be designed for the DC voltage specified, and shall operate satisfactorily between 80% and 110% of rated voltage. Voltage operated relays shall have adequate thermal capacity for continuous operation.

- d) All relays coils requiring a continuous voltage shall have adequate thermal capacity for continuous operation. The current and voltage coil shall be rated for the current and voltage rating specified under system details and auxiliary supply.  
 Opto Inputs: To avoid spurious pickup & mall operation of opto inputs they shall have programmable opto inputs thresholds. Which shall be immune to capacitive discharge, spurious pick up for battery earth fault conditions, switching voltages and also ensure minimum chatters. All BI's & BO's of Numerical relays shall be independent & galvanically isolated. All numerical relays shall be suitable auxiliary supply voltage of 80 -250V DC and BI's shall be suitable for 80-250V DC supply.
- e) The power supply unit shall be fully rated with liberal design in capacity.
- f) The DC supply for solid state relay shall be from DC / DC converters and these shall be amply and fully rated for all operating conditions in service. Provision of DC stand by power supply will however not be acceptable.
- g) The protective relays shall be suitable for efficient and reliable operation of the protection scheme described in the specification. 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, lockout relay monitoring circuits etc. and also required for the complete protection schemes described in the specification shall be provided. 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 contacts as required to complete the scheme, contacts shall be silver faced with spring action. Relay case shall have adequate number of terminals for making potential free external connections to the relay coils and contacts, including spare contacts. Relay cases size shall be so chosen as not to introduce any limitations on the use of available contacts on the relay due to inadequacy of terminals. Paralleling of contacts, if any shall be done at the terminals on the casing of the relay.
- h) All protective relays, auxiliary relays and timers except the lock out relays and interlocking relays specified shall be provided with self-reset type contacts. All protective relays and timers shall be provided with externally hand reset positive action operation indicators with inscription subject to purchaser's approval. All protective relays which do not have built in hand-reset operation indicators shall have

additional auxiliary relays with operating indicators (Flag relays) for this purpose. Similar separate operating indicator (auxiliary relays) shall also be provided in the trip circuits of protections located outside the board such as buchholtz relays, oil and winding temperature protection, sudden pressure devices, fire protection etc.

- i) There shall be no relay in the protective circuits, which shall cause tripping of the circuit breaker when the relay is de-energized.
- j) Timers shall be of electromagnetic or static type. Pneumatic timers are not acceptable. Time delay in terms of milliseconds obtained by the external capacitor/resistor combination is not preferred & shall be avoided.
- k) Provision shall be made for easy isolation of trip circuit of each relay for the purpose of testing & maintenance.
- l) All protective relays & alarm relays shall be provided with one extra isolated pair of contacts wired to terminals exclusively for further use.
- m) The setting range of relays offered, if different from ones specified shall also be acceptable if they meet the functional requirement.
- n) Any alternative/additional protection of relays considered necessary for providing complete effective & reliable protection shall also be offered separately. The acceptance of this alternative/additional equipment shall lie with KPTCL.
- o) 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.
  - i) The operating time of the series seal-in-units 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 the relay.
  - ii) Seal-in-units shall obtain adequate current for operation when one or more relays operate simultaneously.
  - iii) Impedance of the seal-in-units shall be small enough to permit satisfactory operation of the trip coil on trip relays when D.C supply voltage is minimum.
  - iv) Trip-Circuit seal – in is required for all trip outputs irrespective of the magnitude of the interrupted current. The trip-circuit seal-in

logic shall not only seal –in the trip outputs but also the relevant initiation signals to other scheme functions (e.g. initiate signals to the circuit breaker failure function, reclosing function etc.,) and the alarm output signals.

- v) Two methods of seal-in are required, one based on the measurement of AC current, catering for those circumstances for which the interrupted current is above a set threshold, and one based on a fixed time duration, catering for those circumstances for which the interrupted current is small (below the set threshold).
  - vi) For the current seal-in method, the seal-in shall be maintained until the circuit breaker opens, at which time the seal-in shall reset and the seal in-method shall not now revert to the fixed time duration method. For this seal-in method, the seal-in shall be maintained for the set time duration. For the line protection schemes, this time duration shall be independently settable for single –and three –pole tripping.
  - vii) Seal-in by way of current or by way of the fixed duration timer shall occur irrespective of whether the trip command originates from within the main protection device itself (from any of the internal protection functions), or from an external device with its trip output routed through the main protection device for tripping. Trip-circuit seal-in shall not take place under sub-harmonic conditions.
  - p) For numerical relays the scope shall include the following:
    - i) Necessary software & hardware to up/down load the data to/from the relay from/to the personal computer provided in the station.
    - ii) The relay shall have suitable communication facility for connectivity to SCADA. The relay shall be capable of supporting 61850 protocol.
    - iii). Cyber security: The protection relays & control IED's shall be compliant to NERC standard to ensure security & availability of secured data at remote access.
- 27.03 a) The materials, the components of static/ numerical relays shall be designed to withstand the most severe tropical climatic conditions such as corrosive atmosphere, saline, fog, damp, heat and fungus prone environment. These devices as such shall be tropicalised in such a manner so as to meet with the IEC-68 standard.

- b) The components shall be loaded by less than half of their rated values. The resistor shall be of carbon composition or metal oxide type and the capacitors shall be plastic film or tantalum type. Stringent measures including shielding of long internal wiring should be taken to make relays immune to voltage spikes. As per IEC, the relays must meet the requirements of IEC-60255-4, appendix 'E'. Class-III regarding HF disturbance tests, IEC-60255-4 regarding impulse test at 5kV and fast transient test as per IEC-60801-4. Insulation barriers shall be provided to ensure that transients present in CT & VT connections due to extraneous source do not cause damage to static circuits.
- c) The cases, racks and sub-units shall preferably be of stainless steel. The screws used in cases, racks and sub-units shall be either of stainless steel or zinc plated steel.
- d) The material of connector terminal blocks shall be of dielectric moulded type resin. The connector plugs shall be corrosion resistive and the lugs shall be made of tinned brass with the contact face silver / gold plated. All connections with the connector plug shall be by wire wrapping.
- e) The static/ numerical components forming the electronic solid state circuitry shall be mounted on printed circuit board of adequate thickness and made of stratified glass epoxid. A protective lacquer shall be applied when all the components are soldered. Transformers in the circuitry shall also be impregnated with the same lacquer. All components shall be clearly marked and all wiring colour coded and tagged. Flat ribbon cable is exempted from being tagged.
- f) The relays shall be modular units assembled in fully tropicalised draw out cases with the modules or sub-units plugged into racks. They shall be electrically isolated on the measuring side through intensity or voltage input transformers with shield bonded (at the over voltage/fixed voltage) and on the operation side through on/off relays. The layout of measurement inputs, output relays, detection circuits and visual display such as to eliminate mutual interference of the circuits involved. Internal test points shall be provided on the printed circuit at typical points of the relay diagram. These test points, if possible shall be provided on the front of the relay to enable testing during operation without having to disconnect the relay.
- g) Insulation barriers shall be provided to ensure that transients present for CT and VT connections due to extraneous sources do



not cause damage to static circuits. The static relays offered shall be tested to withstand both 5 kV impulse tests and high frequency disturbance stipulated by IEC. Details of the equipment used for tests shall be furnished.

- h) The relay shall be designed for designed for shock wave resistance, temperature resistance, humidity resistance, transportation resistance and storage resistance and to be insensitive to radio frequency interferences.
- i) The performance of static/numerical relay shall not be affected by transient, common mode and transient mode electromagnetic interference.
- j) The solid state relays shall be stable and suitably protected against transient/ induced over voltages and noise signals. The bidder shall state clearly in his bid, special requirements, if any, for DC input arrangement or cabling considered necessary for satisfactory operation of solid state relays quoted by him.
- k) The electromechanical relay contacts shall be protected with non-inflammable plastic covers.

## **28.00 PROTECTION SCHEME:**

**28.01** Protection scheme shall consist of following :

- a) The main protection, distance and differential protection relays are required to protect the 110KV, 66KV lines and 110/33-11KV, 66/33KV, 66/11 KV and 33/11KV Power Transformers and clear the fault within shortest possible time with reliability, selectivity and full sensitivity to all type of faults. The relay shall be fast acting numerical type.
- b) Back up protection shall be of numerical type or Electromagnetic type.

### **28.02 Protection scheme for 110 & 66KV Lines:**

#### **A. Numerical Distance protection scheme for 110 & 66KV Lines:**

Numerical distance protection shall be suitable for use with permissive under reach and over reach required. Relay shall have continuous self monitoring and diagnostic feature.

The detailed description of protection is given here under.

The numerical distance protection shall:

- i. Be suitable for one amp CT secondary and  $110/\sqrt{3}$ V AC Potential from potential transformer of 110KV/ 66 KV Bus.
- ii. Be modular in construction.
- iii. Have high speed switched distance relay for three phase systems to clear all type of line faults within the set reach of the relay, under all operating conditions.
- iv. It should cover at least two line sections completely with 25% additional margin.
- v. Measure all type of faults by switching over to the measuring elements. The reach of each zone shall be independently and individually adjustable over wide range in suitable steps of 1%. Memory circuits with defined characteristics shall be provided in all three phases to ensure correct operation during close-up 3 phase faults and other adverse conditions.
- vi. The protection scheme shall be fast and first zone shall energize the circuit breaker trip coil in about one and half cycle. The tripping time of the second and third zone should be adjustable to any desired value through a separate timing unit.
- vii. Have stepped time distance characteristics and shall have at least two directional and one non-directional independently variable time graded distance protection zones to cover two adjacent line sections.
- viii. (a) Three zones and one reverse zone of operation shall be available. The reach of the relay for zones 1, 2 & 3 should be able to cover line lengths as per clause (iv) above. The relay shall have an adjustable characteristics angle setting range of 30-75 degree.
- (b) Be field selectable for various over reaching, under reaching setting and blocking/ inter tripping communication scheme.
- (c) Have mho / rectangular / polygonal / circular /oval /lens/ quadrilateral characteristics with a facility to set resistance and reactance independently to cater for arc resistance on short lines and load discrimination for long lines.
- ix. Ensure that this long coverage is consistent with limitations imposed by heavy loading and sound phase component of fault current.
- x. The scheme shall not become inoperative even under severe system fault condition near the location of the relay when the potentials applied to the

relay are very small. If characteristics of starting relays are such that it cannot pick-up because of very low infeed, under voltage relays may also be used as supplementary relays.

- xi Have facilities for offset features with adjustable 10-20% of zone -3 setting.
- xii. Have residual compensation variable up to 150%.
- xiii. Operate instantaneously when circuit breaker is closed to zero volt 3 phase fault.
- xiv Have a continuous current rating of two times the rated current. The voltage circuit shall be capable of operation at 1.2 times rated voltage. The relay shall also be capable of carrying a high short time current of 70 times rated current without damage for a period of 1 sec.
- xv Be selective between internal and external faults.
- xvi Include fuse failure protection which shall:
  - a1) Monitor all the three fuses of VT circuit, and associated cable against open circuit.
  - a2) Inhibit trip circuits on operation and initiate annunciation.
  - a3) Have an operating time less than 7 milliseconds.
  - a4) Remain inoperative for system earth faults.
  - a5) Be of solid state type.
- xvii. Have facility for under voltage and over voltage protection.
- xviii. Have self-diagnostic feature.
- xix. Have facility for current & voltage circuit supervision.
- xx. Suitable number of potential free contacts (if required, multiplied through reed relays only) be provided, on each distance scheme.
- xxi. VOID.
- xxii. A separate out of step or power swing blocking relay shall be included to prevent tripping of the breaker during power swings and system disturbances. The breaker shall however be caused to trip if the disturbance lasts for an interval of time equal to or greater than the third zone time setting.

Nevertheless the impedance loci of the distance relays shall be such that they have minimum tendency to operate on power swings caused by system disturbance.

- xxiii. The distance protection scheme shall be suitable for any length (short lengths also) of transmission line. Any limitations in this regard shall be clearly specified by the bidder.
- xxiv. The relay shall have the following features either built-in or separately.
- a) Weakend in feed.
  - b) Power swing blocking.
  - c) Broken conductor detection.
  - d) Fault locator.
- xxv. All trip relays used in transmission lines protection scheme shall be of self/electrical reset type depending on application requirement.

NOTE: Provision of optional features other than those indicated above may be indicated separately. Provision may be made in the relay for updating these optional features at a later date whenever required by KPTCL.

## **B. Protection Scheme for 110 & 66kV Cables**

The Cable protection relays are required to protect the cable and clear the faults on cable within shortest possible time with reliability, selectivity and full sensitivity to all type of faults on lines. In case of 110kV & 66kV XLPE cables the current differential protection will be used as Main protection.

### **Numerical Current Differential Protection Scheme:**

- The line Differential Protection IED (Intelligent Electronic Device) protection relay should be Numerical with full compliance to IEC 61850 standards in every respect and Interoperability with other manufacturers IEDs and tools should be verified.
- The IED shall be suitable for Protection, control and monitoring of overhead lines and cables for all Voltage levels in solidly grounded or impedance grounded networks.
- The protection unit should be based on Phase segregated Line differential Principle and use.
- Advanced and proven algorithms shall support user friendly Engineering tool and Disturbance handling tool.
- It should be possible to integrate Protection and control functionality for several objects in the IED. The IED shall have

complete functionality for single and multi breaker arrangements with single or three phase tripping.

- At least Four/Five independent parameter setting groups shall be included.
- IED shall have extensive self supervision including analogue channels.
- At new installations or at extensions and replacements in existing installations it shall be possible to integrate the IED into a substation automation or monitoring system or use the IED as a stand-alone multifunction unit.
- It shall be possible to equip the IED with a HMI for local access of all information.
- A Restrained dual Bias operate characteristic shall be used and the highest phase current in any line shall be utilized as bias current.
- Charging current compensation for increased sensitivity for long lines and cables shall be included.
- The IED should be suitable for multiplexed, route switched or dedicated fibre networks.
- Two time synchronization methods shall be available, the echo-method when channels with stable and equal delays in both directions are used and GPS to be used in switched networks with unequal channel delays in both directions.
- The communication channel shall be continuously monitored and an automatic switchover to a redundant channel shall be possible.
- IED shall be provided with programmable logic for tripping and indications as well as a high number of logic blocks and timers for user adaptation.
- For Line differential communication it shall be possible to select between a master-master system or master slave system depending on the functional or economical requirements. An automatic changeover to Master-slave communication should take place if an interruption occurs in communication channel in master-master communication system.
- A backup high speed full scheme distance protection with at least three zones should be possible to include in order to get fault clearance in case of communication failure, it shall be possible to have the distance protection continuously in operation or only released for operation at communication failure. The distance Protection shall have characteristics that will give load encroachment discrimination and load current compensation of the reactance line in the first zone to avoid over reach. It should be possible to set the distance Protection zone in forward, reverse or

non directional mode. Each zone should have individual resistive and reactive reach settings. Separate phase selection logic and automatic switch onto fault logic should be included.

- Disturbance recording, event recording shall be built in features and included in the IED.
- IED shall be provided with a front mounted HMI and front port for connection to a Personal Computer.
- The IED shall be provided with communication interface for connection to Substation Automation system and substation monitoring system & SCADA. IEC 61850 communication protocol shall be available. The IED shall meet the IEC 61850 standard in every respect and interoperability with other manufactures IEDs and tools should be verified.
- Power supply modules from 48V to 250V AC/DC shall be available.
- It shall be possible to select different mounting alternatives such as rack, flush or wall mounting. Depending of the required numbers of I/O modules in the IED 1/1 x 19", 3/4 x 19" and 1/2 x 19" cases shall be available.

GPS time synchronization module with GPS receiver used for time synchronization shall be available.

C. Disturbance Recorder (DR) and Event Log (EL) in Numerical relays

- a. The Pre-triggering and post triggering time for recording DR shall be 0.5 and 2.0 second respectively.**
- b. The analog values to be indicated in the DR shall be  $V_a$ ,  $V_b$ ,  $V_c$ ,  $V_n$ ,  $I_b$ ,  $I_c$  and  $I_n$ . The values indicated shall be primary values invariably.**
- c. The DR shall be triggered for operation of MAIN-2 relay, operation of 86 OR 96 of the panel, operation of MAIN-1 relay in some cases.**
- d. The binary status mapped to DR shall be CB status on each phase, Trip relays operated, zone1 start, zone2 start, zone3 start, zone4 start, zone1 trip, zone2 trip, zone3 trip, zone4 trip, carrier received, carrier sent, carrier faulty, CB not ready, Trip A phase, Trip B phase, Trip C phase, AR operated, TOR operated, AR block, SOFT operated, DEF start, DEF trip, DOC start, DOC trip, Fuse fail operated, OC operated, EF operated, PSB operated, Broken conductor operated, Pole Discrepancy operated, LBB**

**operated, any other external binary input given for triggering of DR like MAIN-1 in some cases.**

- e. Event Log (EL): The Event Log of all the above binary status for pick up and drop out with timing shall be incorporated in the EL report.**

**1. Station name:**

**Object name – (Main/Back up)**

**Line Name:**

**Line length.**

**Triggering signal:**

**Triggering date and time:**

**Record No:**

**Fault locator: (Distance of the fault in kM)**

**2. Analog values of pre-fault voltages and currents with angle of the phasor.**

**3. Watch dog contact.**

**D. Fault Locators:**

The fault locator shall be based on the impedance measurement of the line and shall be microprocessor based only. It shall be capable of measuring the location of the fault from the relaying point with an accuracy of 3% or better, for all types of faults including broken conductor detection. It shall be ON LINE type. The fault locator shall measure the measuring signals prior to the fault, during fault, before tripping of the breaker and store them in the memory and process them at later stages. The accuracy of the measurement shall not be affected / influenced by line loading prior to the fault, remote in feed, magnitude of the fault resistance or mutual effect of parallel line(s), CVT transients, DC component of in fault current, heavy load conditions, temperature variations, frequency divisions. The fault locator shall have built in display unit for showing fault location, faulty phase(s), current and voltage magnitudes and their phase relationships. The fault locator shall be capable of being combined with the respective distance protection for phase selection information. The calculation of line protection shall take place when any of the line protections operate on fault. The calculation by the fault locator shall be based on measuring values prior to and during the fault. These data shall be stored in the memory of fault locator and calculation shall be made after tripping of the line breakers. The distance to fault shall be shown as % of line length or actual fault

location in KM. The fault locator shall be suitable for its application with three (3) cycle circuit breaker. Fault locator shall have facilities to provide remote indication at central load dispatch / management centre via communication channels, which will be provided in near future. printer/display unit may be common for all the lines in each station. The fault locator shall be provided with additional contacts for starting printer and signaling for faults inside the fault locator.

NOTE: Provision of optional features other than those indicated above may be indicated separately. Provision may be made in the relay for updating these optional features at a later date whenever required by KPTCL.

#### **28.04. Protection scheme for 110/33-11KV, 110/11kV, 66/33KV and 66/11kV Power Transformer Numerical Differential Protection.**

##### **A) Numerical Differential Relay**

- a) It shall consist of fully numerical/digital type, variable percentage, biased type differential relay. It shall be triple pole type, with faulty phase identification/ indication.
- b) The percentage bias shall be low near rated current, sufficient to allow for OLTC tap variation and CT errors, but shall increase automatically for severe through faults to ensure stability even under CT saturation errors. It shall offer low burden to CTs.
- c) The relays shall be suitable for rated current of 1 Amp and have three instantaneous high set over current units.
- d) The relay shall remain stable under initial magnetizing inrush current, sympathetic inrush when adjacent transformers are charged, through fault stability and over fluxing conditions. The relay shall have second harmonic restraint feature.
- e) The relay shall be very fast in operation with an operating time not greater than 30 milli seconds at 5 times setting.
- f) The relay shall be accompanied by interposing auxiliary current transformers for angle and ratio correction or have internal features in the relay to take care of angle and ratio corrections.
- g) The bias setting of the relay shall be adjustable with range of 20 – 50 %.
- h) The relay shall have a disturbance feature to record graphic form of instantaneous values of current in all two/three winding



transformer in 6 analog channels, during faults and disturbances for pre fault and post fault period. The disturbance recorder shall have the facility to record the following external digital channel signals apart from the digital signals pertaining to differential relay.

- i) REF Protection operated.
- ii) HV & LV breaker status.
- iii) Bucholtz/OLTC surge relay alarm / trip.
- iv) WTI/OTI/PRD alarm/trip of transformer necessary hardware and software for down loading the data captured by disturbance recorder to personal computer available in the sub-station automation system shall be included in the scope.

**B) Restricted Earth fault Protection:**

The restricted earth fault protection shall

- a) Be single pole Numerical type.
- b) Be of high speed, instantaneous current operated and high impedance type.
- c) Have a current setting range of 10-40% of 1 Amp.
- d) Be tuned to the system frequency. It shall have high rejection of DC component of fault current.
- e) Have suitable non-linear resistor to limit the peak voltage to 1000 volts.

**C) Over fluxing protection : VOID:**

**D) Transformer overload relay:**

Transformer overload relay shall be provided with two stages. One stage as non-trip alarm & the second stage is to extend trip command to breakers to have required load relief.

**E) Auxiliary relay:**

The transformer protection panel shall be wired for buchholz alarm and trip, oil temperature alarm and low oil level. The auxiliary flag relays shall be provided for contact multiplication wherever they are needed for buchholz alarm/trip, winding temperature alarm/trip, oil temperature

alarm/trip, pressure relief device trip, oil surge relay trip. Current operated relays shall be preferred to voltage operated relays.

**Note:** REFT & auxiliary relays shall be separately provided externally and shall not be inbuilt features of differential relay.

## **28.05 BACK UP PROTECTION:**

28.05A) Back-up Directional over Current & Earth fault protection scheme for 110kV & 66kV Lines & UG Cable:

- Shall have three over current and one earth fault element (s) which shall be either independent or composite unit (s).
- Shall be of Numerical type.
- Shall include necessary VT fuse failure relays for alarm purposes.
- Shall be provided with LBB protection as inbuilt function of Backup OCR& EFR relay.
- Shall (for over current protection)
  - have IDMT characteristic with a definite minimum time of 3.0 seconds at 10 times setting
  - have a variable setting range of 50-200% of rated current.
  - have a characteristic angle of 30/45 degree lead.
  - include hand reset flag indicators or LEDs.
- Shall (for earth fault protection)
  - have IDMT characteristic with a definite minimum time of 3.0 seconds at 10 times setting
  - have a variable setting range of 20-80% of rated current.
  - have a characteristic angle of 45/60 degree lead.
  - include hand reset flag indicators or LEDs.
  - include necessary separate interposing voltage transformers or have internal feature in the relay for open delta voltage to the relay.
- i. The operating coil of the DEFR shall be connected in the residual circuit of the star connection of the line CT's. The polarizing voltage for DEFR shall be obtained from the open delta connection of the VT secondary circuit.

- ii. The backup protection as aforesaid shall operate independently of the main protection distance relay, to provide protection for the line section, in the event of failure of the distance relays, to clear the faulty section or failure of the main protection scheme relay.
- iii. It should be possible to convert the directional relays to non-directional type by suitable means.

28.05-B) Numerical Back-up Over Current & Earth fault protection scheme with high set feature for Power Transformer:

- Shall have three over current and one earth fault element (s) which shall be either independent or composite unit (s).
- The scheme shall include necessary VT fuse failure relays for alarm purposes.
- Shall be provided with LBB protection as inbuilt function of Backup OCR& EFR relay.
- Over current relay shall
  - have directional IDMT characteristic with a definite minimum time of 3.0 seconds at 10 times setting and have a variable setting range of 50-200% of rated current.
  - have low transient, over each high set instantaneous unit of continuously variable setting range of 500-2000% of rated current.
  - have a characteristic angle of 30/45 degree lead.
  - include hand reset flag indicators or LEDs.
- Earth fault relay shall
  - have directional IDMT characteristic with a definite minimum time of 3.0 seconds at 10 times setting and have a variable setting range of 20-80% of rated current.
  - have low transient, over each high set instantaneous unit of continuously variable setting range 200-800% of rated current.
  - have a characteristic angle of 45/60 degree lead.
  - include hand reset flag indicators or LEDs.
  - include necessary separate interposing voltage transformers or have internal feature in the relay for open delta voltage to the relay.
- i. The backup protection as aforesaid shall operate independently of the main protection differential relay, to provide protection for the

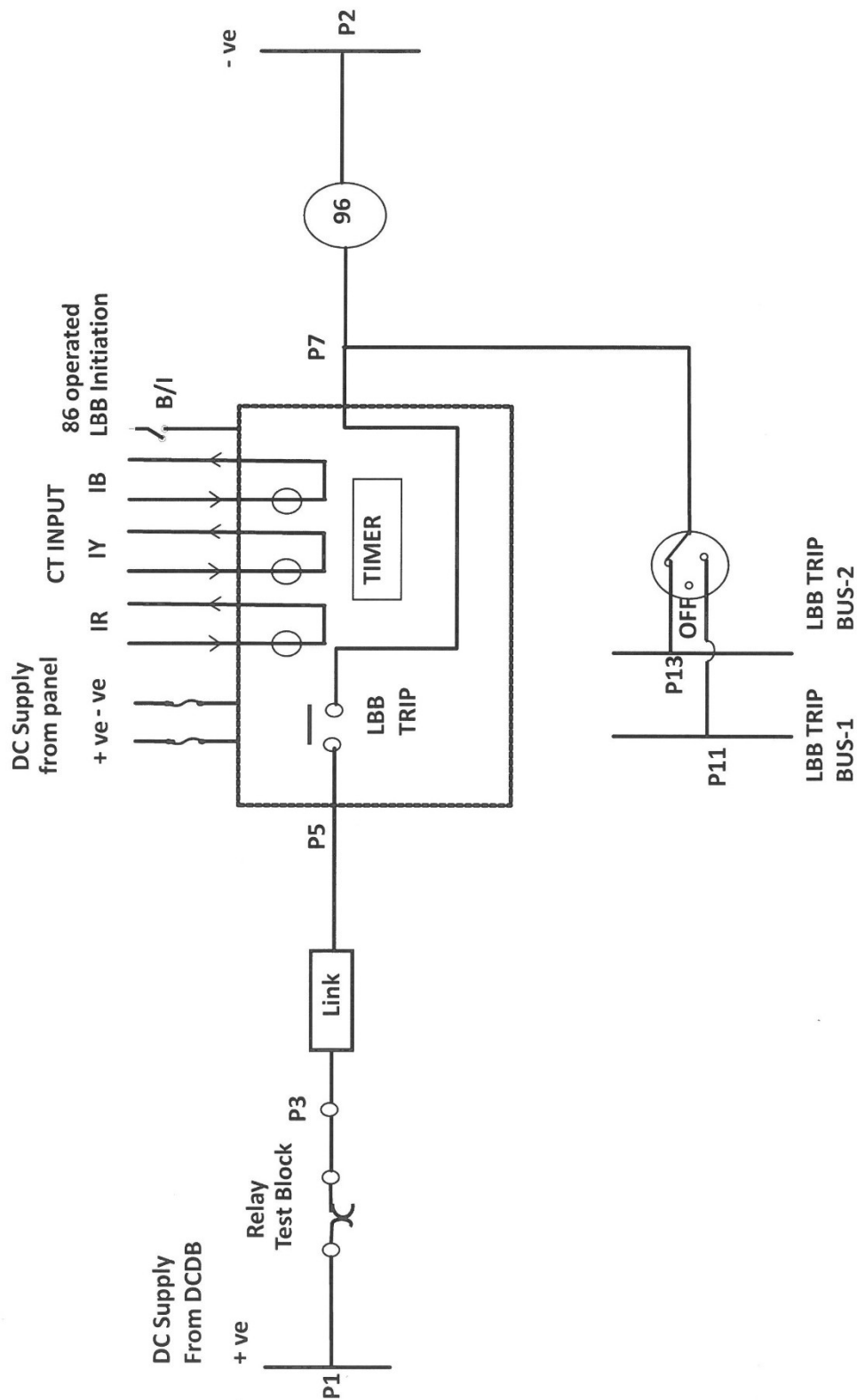
transformer section, in the event of failure of the differential relays, to clear the faulty section or failure of the main protection scheme relay.

- ii. It should be possible to convert the directional relays to non-directional type by suitable means.

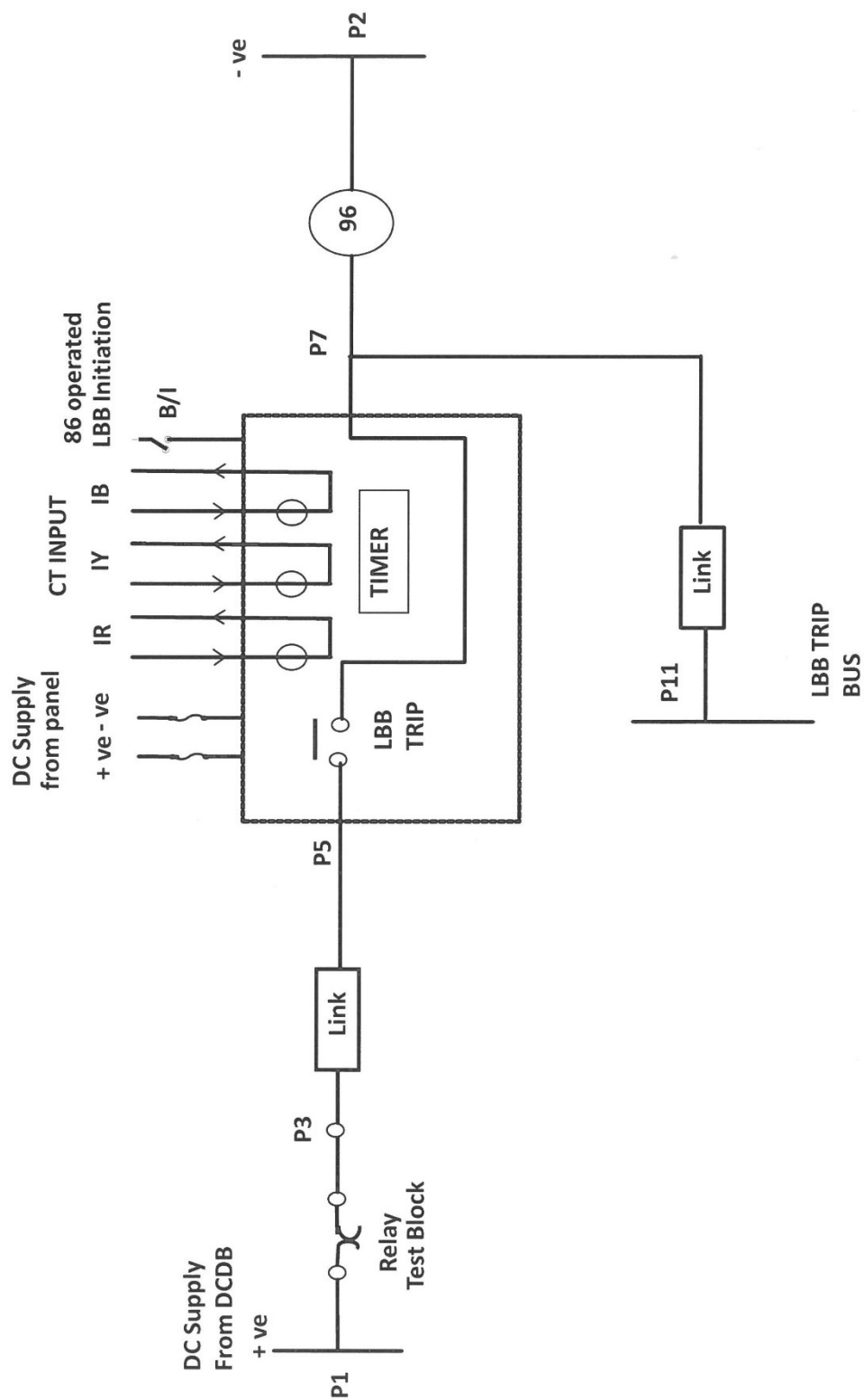
**28.06 Local Breaker Back up protection:** LBB protection as inbuilt function of backup protection relay shall be provided for lines and Transformer.

# LBB SCHEMATIC DIAGRAM FOR DOUBLE BUS SYSTEM

Annexure-4



# LBB SCHEMATIC DIAGRAM FOR SINGLE BUS SYSTEM



### **28.07 Bus Coupler Panel: VOID:**

### **28.08 Tripping Relay:**

Each panel shall be provided with instantaneous DC operated tripping relay. The relay shall have adequate number of normally open and normally close contacts to meet the requirement of scheme, other functions like auto re-closing relay, LBB relay, fault locator disturbance recorder, event logger wherever applicable. The maximum operating time of the relay shall not exceed ten milliseconds and reset within 20 milliseconds. Relay shall be provided with operation indicator for each element coil.

### **28.09 Tripping Circuit Supervision Relay.**

- a) Each trip coil of circuit breaker shall be provided with an independent trip circuit supervision relay. These relays shall be mounted in the control panel associated with the circuit breakers. In 110KV, 66KV & 33KV CB there will be 2 nos. of trip coils for all the three poles of CB.
- b) These relays shall monitor the healthiness of each phase of the trip circuit while the breaker is in open or closed position and give an alarm for the loss of DC supply or for faults in the trip coil or for faults in the trip circuit such as leads, auxiliary contacts. The relay shall have a time delay on drop off of not less than 200 milliseconds and be provided with operation indication.
- c) Trip supervision relay shall be located in the panel.
- d) The relay shall have adequate contacts for providing connection to alarm and event logger.

### **28.10 DC Supply monitoring relay:**

The relay shall be capable of monitoring the failure of DC supply to which it is connected. Separate DC supply monitoring relay shall be provided for DC main circuit, control circuit of tripping relay and protection circuit of each panel. It shall have adequate potential free contact to meet the scheme requirement. The relay shall have a time delay on drop off of not less than 100msecs and be provided with operation indicator/flag. Indicating lamp and separate alarm for DC fail shall be provided and shall be operated by 230V AC single phase supply. Push buttons for test and accept shall be provided.

### **28.11 Voltage Selection Relay: VOID:**

### **28.12 INTERLOCKING:**

The control circuits for operation of the disconnecting switches in the line shall be so designed that the following interlocking features are provided for usual conditions of operation and all the necessary devices, auxiliary relays shall be included in the supply of control panels.

The other interlocks required are (a) it should not be possible to operate either of the bus selector isolators unless the other bus selector isolator, bypass isolator and line breaker is in de-energized condition. (b) it should not be possible to operate the by-pass isolator when the main breaker and the breaker disconnect isolators (on either side of the breaker) all are in closed position. (c) during change over from the line breaker to bus coupler control, both breakers will be closed and it will be necessary to close both the bus selector isolators for making the change over. The interlock required is that it should not be possible to operate either of the bus selector isolators when the line is in service, unless the bus coupler is also closed. (d) If the earth switch of the line isolator is connected to ground, it shall not be possible to close the bus isolator, by-pass isolator or the line isolator or the breaker.

### **28.13 Time Synchronization Equipment: VOID:**

### **28.15 Rely Test Kit: Void:**

### **28.16 VOID:**

## **29.00 PROTECTION PHILOSOPHY:**

### **A) 110 KV / 66 KV LINE PROTECTION**

Numerical distance scheme as principal protection and directional over current / directional earth fault numerical relays as back-up protection. The back-up protection shall operate independent of primary protection. In addition to this, if cable is used for lines, line differential protection is used as Main protection and directional over current/directional earth fault relays as back up protection.

The voltage source for protection and meter circuits of the line feeder will be from the bus VTs.

### **C) Power Transformer Protection:**

The protection scheme should trip the circuit breaker on HV and MV/ LV side of transformer for any fault in the transformer.

- a) The differential protection scheme and REF as principle protection.



- b) The directional numerical OCR / EFR provided on HV side and DOCR/DEFR provided on MV/LV side shall act as back up protection.
- c) VOID.
- d) The trip impulses received from Buchholz relay, winding temperature relay, pressure relief device, oil surge relay etc., provided by the transformer manufacturer, shall trip the breaker through an auxiliary relay.
- e) The necessary matching transformers required for the protection scheme shall be supplied by the bidder and is deemed to be part of differential protection.
- f) The back up protection shall operate independent of primary protection.

**D) Bus Bar Protection: VOID:**

**30.00 Co-ordination of Drawings of associated equipments of other manufacturers:**

- 1. The purchaser intends to procure all outdoor equipments associated with these control and relay panels from other manufacturers. The supplier is therefore required to co-ordinate the control and wiring schematics of these control and relay panels with control and wiring schematic of the outdoor equipment manufacturer.
- 2. The purchaser will intimate the supplier the details of the outdoor equipments manufacturers on whom purchaser orders have been placed for the supply of these equipments along with such relevant details such as P.O. No. and date, delivery period, and all other technical details such as rating data, wiring diagrams etc. The supplier shall co-ordinate these diagrams with that of the associated control and relay panels, and shall also seek such clarifications as are necessary from these manufacturers under intimation to the purchaser.
- 3. The purchaser will assist and or furnish the supplier with all relevant data as are necessary for completeness of co-ordination of the wiring diagrams and interlocking of equipment circuits.

**31.00 DRAWINGS AND LITERATURES:**

### **31.01 Tender drawings and literatures:**

The following drawings and literatures shall be submitted along with tender documents.

- a) Principal layout drawings of the SIMPLEX control and relay panels with mimic bus, disposition of meters, control switches, relays and annunciator panel, synchronizing trolley etc. These layout drawings shall be for the following views:
  - i. Front face of panel.
  - ii. Inside view of panel.
- b) Illustrated literature with photographs of similar panels supplied by the manufacturer.
- c) Pictorial and sectional views of control switches, test terminal blocks, indicating instruments, exploded views of draw out type instruments etc.,
- d) Printed copies of illustrated, literature, general technical data, performance application, and specifications of relays, fault locators, etc.,
- e) Elementary schematic wiring diagrams of the various metering and protective schemes.

### **31.02 Contract Drawing:**

In the event of an order, the supplier shall submit drawings in triplicate for approval of the purchaser, prior to manufacture. After the drawings are approved six copies of each of the drawings printed on 90 GSM paper shall be supplied for immediate use. The successful bidder should forward the drawings as follows.

- a) One set of reproducible, originals and 12 sets of blue print copies of all approved drawings along with 12 sets of literature commissioning and maintenance manuals to the Chief Engineer, Electy, Tendering & Procurement, KPTCL, Cauvei3r Bhavan, Bangalore -560 009.
- b) Three sets of blue print copies of all approved drawings along with three sets of literature and manuals to each of the consignee.
- c) Non supply or part supply of drawings, literature and manual will be deemed as incomplete supply of equipment.

The contract drawing shall cover the following

- a) Principal layout drawing as per clause No. 29.01 (a).

- b) Details of construction and dimensions of the cubicle and complete switch board.
- c) Foundation drawings indicating the cable entries and trenches etc.
- d) Elementary diagrams of all controls, metering, protection, annunciation and other circuits. All devices shall be numbered according to ASA code.
- e) Cabling and wiring diagram of the front and rear cubicles and interconnections between them. Ferrule numbers device members, grouping for cable take off etc., shall be distinctly shown.
- f) Inter-connection diagram between switch board and switchgear equipment, power transformers, instrument transformers and other associated equipment.
- g) Dimensional outline, drilling diagram and special mounting arrangement, if any of each type of the various devices on the switch board.
- h) Individual internal wiring diagram of all devices and elementary wiring diagrams or relays for internal wiring.
- i) Construction details of the switches, terminal block and test blocks Etc.

### 31.03 **LITERATURE:**

In the event an order, seven copies of each set of the following literatures shall be supplied.

- a) Literature describing construction, operation, testing, calibration, adjustment, rating specifications, setting details of all the protective and auxiliary relays, and control switches.
- b) Literature giving rated data, details of adjustments for calibration for the indicating instruments and integrating instruments.
- c) List of spare parts, identification number from removable parts of relays, instruments and switches etc., with the help of which the purchaser will be able to procure spare parts from the supplier at any subsequent time.
- d) Performance application of relays.
- e) Detailed internal drawings of all units/ schematic of all, PCB's of the relays, reference voltages at convenient rest points, functional description, operational details. This is essential for trouble shooting of the relays.

The literature shall contain wave forms/ voltages etc at selected points for easy identification of faulty units in the modules unit.

- f) The literature shall contain wave forms / voltages etc at selected points for easy identification of faulty units within the modular unit.

### **32.00 TESTS, TEST CERTIFICATES AND INSPECTION:**

32.01 The following routine tests shall be carried out on the panels at the factory:

- a) Checking of overall dimensions, thickness of panel sheet and paint
- b) Checking wiring and continuity of circuits.
- c) One minute HV withstand test – All equipment on panel internal wiring shall be tested to withstand a voltage of 2 KV to earth for one minute.
- d) Insulation resistance of the complete wiring circuit with all equipment mounted on the panel.
- e) Verification of degree of protection as per IS –2147

32.02 All relays shall be subject to type tests and routine tests as per relevant standards, that is IS-3231 or IEC 255.

32.03 All other components including instruments and accessories installed within the panel shall be subject to type tests, routine tests and acceptance tests, according to the standards to which they conform.

32.04 All routine and acceptance tests shall be conducted in the presence of the purchaser's representatives. No material shall be dispatched unless the purchaser communicates his written approval to these test certificates.

### **32.05 Type Tests Reports:**

The reports for following type tests shall be submitted by the bidder for the protective relays, fault locator, Disturbance recorder and Event logger.

- a) Insulation tests as per IEC 60255-5
- b) High frequency disturbance test as per IEC 60255-4( Appendix-E) – Class III (not applicable for electromechanical relays)
- c) Fast transient test as per IEC 1000-4 level III (not applicable for electromechanical relays).

- d) Relay characteristics, performance and accuracy test as per IEC 60255
  - o Steady state characteristics and operating time.
  - o Dynamic characteristics and operating time for distance protection relays and current differential protection relays.
  - o For disturbance recorder and event logger only performance tests are intended under this item.
- e) Tests for thermal and mechanical requirements as per IEC 60255-6
- f) Tests for rated burden as per IEC 60255-6
- g) Contact performance test as per IEC 60255-0-20 (not applicable for Event logger distance to fault locator and Disturbance recorder).

32.06 Steady state & dynamic characteristics test reports on the distance protection relays as type test, shall be based on general guidelines specified CIGRE Committee 34 report on evaluation of characteristics and performance of power system protection relays and protective system A on simulator/network analyzer /PTL alternatively, the files generated using electromagnetic transient programme (EMTP) can also be used for carrying out the above tests Single source dynamic tests on transformer differential relay shall be /should have been conducted based on general guidelines specified in CIGRE committee 34 report.

### **33.00 Spares**

- 33.01 The tenderer shall recommend in his offer a set of spares as are required for a period of 5 (five) years in respect of relays and instruments quoted. All like spare parts shall be interchangeable with respect to each other and shall therefore be suitable for the parts/components that they would replace.
- 33.02. The tenderer shall indicate the life expectancy or shelf life of all such spares and their recommended method of storage.
- 33.03 Itemized unit price rate for each component shall be furnished in the schedule of prices in tender proposal sheets. The purchaser reserves the right to order for the spares which in his assessment are actually required.

### **34.00 MAINTENANCE TOOLS AND EQUIPMENT:**

- 34.01 a) The tenderer shall offer in his tender a set of special tools as are necessary for routine maintenance and testing of the equipment. These shall include amongst others relay test jacks, patch cords, etc.

- b) The tenderer is required to supply these tools arranged neatly in wooden boxes.

34.02 a) The tenderer shall offer in his tender, instruments and equipment's for conducting tests on relays and instruments. The relay testing kits shall be suitable for conducting dynamic tests on the relays to ascertain their characteristics as also to conduct periodical calibration and maintenance tests.

- b) The testing kits, shall be self-contained compact portable units with built in power supply units and timers. If the test equipment contains more than one unit then no extensive inter unit wiring shall be involved at site. The kits shall be capable of being operated off the auxiliary AC & DC power supplies specified in this tender document.

34.03 Itemized unit price rate of each such tool/equipment shall be furnished in the schedule of prices in tender proposal sheets.

### **35.00 QUALITY ASSURANCE PLAN:**

The tenderer shall invariably furnish the following information along with his offer failing which his offer shall be liable for rejection.

- a) Names of sub-suppliers of individual accessories.
- b) Information and copies of test certificates in respect of bought out accessories.
- c) List of manufacturing facilities available.
- d) List of areas in manufacturing process where stage inspections are carried out for quality assurance and details of such tests and inspection.
- e) The type tests certificates not older than Seven (07) years as on the last date of submission of bid..

**35.01 The supplier shall within 30 days of placement of order, submit following information to the purchaser.**

- i) List of bought out accessories and the names of sub-suppliers selected from those furnished along with offer.**
- ii) Type test certificates of the bought out accessories.**
- iii) Quality assurance plan (QAP) with hold points for purchaser's inspection. The quality assurance plan and hold points shall be discussed between the purchaser and supplier before the QAP is finalised.**

**35.02 The supplier shall submit the routine test certificates of bought out items, at the time of routine testing of the fully assembled panel.**

### **36.00 MINIMUM EXPERIENCE FOR QUALIFYING AS A TENDERER :**

- i. Tenderers shall have a minimum experience of five years in the design, manufacture, testing and commissioning of Control and Relay panels, similar to the type specified in the present enquiry. At least 50% of the quantity of similar type of main protection relays i.e., distance and differential, over fluxing, REF relays and Bus bar protection relays called for in the present enquiry shall be in successful operation for a minimum period of two years. The tenderer shall furnish performance certificate for satisfactory operation of similar main protection relays for a minimum period of two years. The tenderer shall furnish the type test certificates for tests conducted on a similar relay not later than Seven years as on the last date of submission of bid..**
- ii. The tenderer should be the original manufacturer of at least 50% of the total relay types mentioned, viz., distance relays, auto re-close relays, differential relays and back up protection relays, High speed trip relays, LBB, Bus bar protection relays, over-fluxing and REF relays.**
- iii. The purchaser however reserves the right to waive the minimum experience condition stipulated in clause 36.00 (i) in case of Firm having collaboration with well experienced Firms. The experience of the collaborating Firms in the manufacture of similar type of main protection relays shall be not less than five years. The waiving of minimum experience condition will be considered by the purchaser only on furnishing the performance guarantee for the main protection relays manufactured by the collaborating Firms.**

### **37.00 PERFORMANCE GUARANTEE :**

**The control and relay panels along with the main protection relays offered shall be guaranteed for satisfactory performance for a period of 42 months from the date of satisfactory commissioning of C & R Panels. The equipment/relays if found defective/failed within the above guarantee period shall be replaced or repaired by the supplier free of cost within one month from receipt of intimation. If the defective/failed equipments/relays are not replaced/repared as per the above guarantee clause, the corporation shall recover an equivalent amount plus 15% supervision charges from any of the supplier's bills.**

### **38.0 TRAINING TO BOARD ENGINEERS :**

**38.01 The purchaser requires that training be imparted to eight Engineers of the Purchaser's organization in the testing, commissioning, calibration, adjustment, trouble shooting and attending to routing defects, mal-**

operations in the relays and instruments supplied. Such training shall be imparted at the supplier's works for a period of not less than 2 (two) weeks and shall be imparted free of cost. The to and fro travel expenses of these Engineers will be borne by the purchaser. However boarding, lodging and other incidental expenses related there to shall be borne by the supplier.

**38.02** In case training is to be imparted at the works of the supplier's collaborators. Then the same shall be arranged for by the supplier.

**38.03** The training shall be imparted before dispatch of the equipment.

**39.0** DESPATCH :

**39.01** The control and relay panels shall be dispatched in suitable crates with all instruments, relays, switches and other devices mounted in position and wired. Instruments which cannot be sent in this manner may be separately dispatched.

**39.02** The detailed dispatch schedule for each control & relay panel board shall be supplied well in advance. In the schedule, items accompanying the control panel items separately despatched in crates and items for which only drilling and wiring is provided shall be separately listed.

**39.03** The packing list for each shipment shall indicate complete details of equipment being shipped to enable to consignee to identify the parts and to ensure that no equipment stated to have been shipped has either lost in transit or if damaged, to initiate replacement proceedings and also to enable the insurance claims to be preferred. If the invoice does not contain full details, if any part not specifically mentioned in the packing list is missing in transit the supplier shall be responsible for supply of such parts to the purchaser without any extra cost.

**40.0** DEVIATION FROM TECHNICAL SPECIFICATIONS :

**40.01** The tender can suggest modification in the protective scheme detailed in the specification if it improves the discrimination selectivity and overall performance of the protection scheme, clearly giving all the details.

**41.0** SCHEDULE OF REQUIREMENTS AND DELIVERY :

**41.01** The schedule of requirement of components is detailed in annexure. The tenderer should furnish the breakup prices for various relays and meters for future addition and deletion.



- 41.02 Station wise schedule of requirement along with the desired delivery is detailed in Annexure. In case of new stations the basis of comparison will be on package basis i.e. on the complete requirement of a station.**
- 41.03 The purchaser may ask for addition or deletion of some items during the time of verification of drawings. The Firm shall agree to supply any additions (at extra cost, if any).**
- 41.04 VOID:.**
- 41.05 VOID:**
- 42.00 SCHEDULE OF PRICE:**
- 42.01 The tenderer should furnish the schedule of prices for each type of panel station wise. The supplies should be complete in all respects as stipulated in annexure and preference will be given to teneederers who confirm that this delivery can be met. The tenderer should indicate in this offer the breakup of time required for (1) collecting design parameters from purchaser, (2) Designing of panels and preparation of detailed drawings, (3) Approval of drawing, (4) fabrication of panels and testing and (5) transportation to site. This information will be used for the purpose of calculating penalty etc.**
- 42.02 The tenderer shall furnish the breakup price for each of the component of panels. Decision in regard to adding or deleting any of the component rests with the purchaser.**
- 43.01 The tenderer should furnish the guaranteed technical particulars as called for in Annexure, failing which the offer is liable to be overlooked.**
- 43.02 Guaranteed technical particulars for panels for different voltage class shall be furnished separately.**

## **SCHEDULE OF REQUIREMENT OF ANNUNCIATOR WINDOWS**

### **I. 110/66 KV LINE:**

#### **TRIP ALARMS:**

1. Distance protection operated.
2. DOCR/ DEFR/LBB operated.
3. VOID.

#### **NON TRIP ALARMS:**

1. Trip circuit supervision alarm TC I.
2. Trip circuit supervision alarm TC2.
3. VT fuse failure alarm,
4. Carrier failure.
5. SF6 Gas pressure low.
6. Air pressure low.
7. DC fail to distance protection /control circuit.
8. Breaker lockout.
9. Spares one no.

### **II POWER TRANSFORMER PANEL 110/11KV OR 66/11KV:**

#### **A TRIP ALARMS:**

1. Differential relay trip operated,
2. REFR operated.
3. Transformer over current relay operated.
4. Transformer earth fault relay operated.
5. Buchholtz trip operated.
6. Oil temperature high trip.
7. Winding temperature very high trip,
8. OLTC surge relay trip/diverter switch trip.
9. Pr. Relief device trip.
10. Local breaker back up protection operated.

#### **B NON TRIP ALARM:**

1. Buchholtz alarm.
2. Winding temperature high.
3. Oil temperature high,
4. Trip circuit supervision TC 1.
5. Trip circuit supervision TC2.
6. Circuit breaker lockout.
7. Transformer control DC fail.

8. SF6 gas pressure low.
9. Air pressure low,
10. Transformer oil level low.
11. Spares four nos.

### **III 33 KV FEEDER :**

#### **TRIP ALARMS:**

1. OCR operated
2. EFR operated

#### **NON TRIP ALARMS:**

1. Trip circuit supervision alarm TC1.
2. Trip circuit supervision alarm TC2.
3. SF6 gas pressure low.
4. Air pressure low.
5. Breaker lockout.
6. Spares 4 nos.
7. DC fail.

## SECTION 9.0 – C & R PANELS

### ANNEXURE – CRP – 4

#### CONTROL, METERING AND RELAY PANEL FOR 110/66 KV FEEDERS (TYPE 1L – FOR 110 KV FEEDER) (FTYPE 6L – FOR 66 KV FEEDER)

The C & R Panel shall generally consist of following items.

##### **A. CONTROL AND INDICATION PANEL:**

Sl. No.	Particulas	Quantities 1 L	Quantities 6 L
1	METERING DEVICE		
	a) AC ammeter dual range 0-400/0-800 Amp	3 Nos.	3 Nos.
	b) Multi functional Meter	1No	1No
	c) AC 3 phase, 4-wire CT/PT operated electronic trivector meter accuracy 0.2S with ABT & TOD features & DLMS compliant shall confirm to detailed specification furnished	1 No.	1 No.
	d) Test terminal block	1 No.	1 No.
2	CONTROL DEVICES:		
	a) Control switches for remote Control of 110/66 KV CB	1 No.	1 No.
3	INDICATION AND ANNUNCIATION DEVICE		
	a) CB status indication lamps with accessories	1 Set	1 Set
	b) Isolator status indicating lamps with all accessories	2 Sets Refer notes	6 Sets Refer notes
	c) AC indicating lamp for DC fail	1 Set	1 Set
4	OTHER DEVICE:		
	a) PVC Circuit label	2 Nos.	2 Nos.
	b) Painted Aluminium strip showing the single line diagram	1 Set	1 Set
	c) Internally mounted equipment	1 Set	1 set
	d) Label indicating manufacturer's name, PO details, drawing reference no. etc.,	1 No	1 No
	e) Annunciation windows with etching, lamps, Test/acknowledge/ reset push buttons etc.,	1 Set	1 Set
	f) Selector switch for selecting	1 No	1 No

	Remote/SCADA.		
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## B. RELAY PANELS:

<b>1</b>	<b>MAIN PROTECTION RELAYS</b>		
	a) Numerical distance scheme suitable for 3 phase tripping with other features as described in the detailed specification	1 Set	1 Set
<b>2</b>	<b>BACK UP PROTECTION</b>		
	a) Numerical Directional over-current and earthfault potentially polarized IDMT relay with built-in LBB protection function	1 No	1 No
<b>3</b>	<b>AUXILIARY RELAYS:</b>		
	a) Trip circuit supervision relays	2 Sets	2 Sets
	b) Tripping relay (1 for main 1 for backup protection)	1 Set	1 Set
	c) DC supply monitoring relay	1 Set	1 Set
	d) Annunciation relays and other relays	As required	As required
	e) Breaker failure trip relay	1 No	1 No.
<b>4</b>	<b>OTHER DEVICES:</b>		
	a) Test terminal box	If required (see note)	If required see note
	b) PVC circuit labels	2 Nos	2 Nos
	c) Label indicating manufacturer's name, PO details, drawing reference no. etc.,	1 No	1 No
	d) Internally mounted equipments	1 Set	1 Set

## NOTE:

1. Other accessories required for operation of the protective Scheme including interconnections shall be included.
2. Numerical distance scheme shall be suitable for all line lengths. Any limitation shall be clearly specified.
3. Separate fuse failure relay with suitable annunciation is to be provided in case the same is not in-built.

4. Optional reading devices, software etc., required for setting, reading of the meter etc., deemed to be included.
5. The devices in addition to name plate, shall have labels indicating the function that are part of that particular relays and their codes in the drawings.
6. Common bell, hooter, associated annunciation relay can be located in any one of the 110/66/33KV panels and shall be separate for each voltage class and can be mounted in one of the line /bus coupler panel of the same voltage class.
7. TTB for protection circuit to be provided if the relays are of non draw out type.
8. Transducer shall be provided for WATT meter / VAR meter.

## SECTION 9.0 – C & R PANELS

### ANNEXURE – CRP – 5

#### CONTROL, METERING AND RELAY PANEL FOR 110/33KV 110/11KV AND 66/11KV DELTA-STAR POWER TRANSFORMER

(TYPE 1T3 FOR 110/33KV TRANSFORMER)  
(TYPE 1T1 FOR 110/11KV TRANSFORMER)  
(TYPE 6T1 FOR 66/11KV TRANSFORMER)

The C& R Panel shall generally consist of the following items.

##### A. CONTROL AND INDICATION PANEL:

Sl. No.	Particulars	Quantities		
		1T3	1T1	6T1
<b>A1</b>	<b>METERING DEVICE</b>			
	H V SIDE:			
	a) AC ammeter Range 0-100/0-200 Amps	3 Nos	3 Nos.	3 Nos
	b) Multi functional Meter	1No	1No	1No
	c) AC 3 phase, 4-wire CT/PT operated electronic trivector meter accuracy 0.2S with ABT & TOD features & DLMS compliant shall confirm to detailed specification furnished	1 No.	1 No	1 No
	d) Test terminal block	1 No	1 No	1 No
	MV SIDE:			
	a) AC Ammeter Range ( 0-200 / 0-400 A)	3 No.	---	---
	b) AC 3 phase, 2 element electronic trivector meter of accuracy 0.2	1 No.	---	---
2	CONTROL DEVICES;			
	HV SIDE:			
	a) Control switches for remote control of 110/66 KV CB	1 No	1 No	1 No
	MV SIDE:			
	d) Control switches for remote control of 33 KV CB	1 No	---	---

## SECTION 9.0 – C & R PANELS

Sl. No.	Particulars	Quantities		
		1T3	1T1	6T1
<b>3</b>	<b>INDICATION AND ANNUNCIATION DEVICE:</b>			
	HV SIDE:			
	a) CB status indication lamps with all accessories	1 Set	1 Set	1 Set
	b) Isolators status indication lamps with all accessories	2 Sets	2 Sets	2 Sets
	e) AC indication lamp for AC fail	1 No	1 No	1 No
	MV SIDE:			
	a) CB Status indication lamps with all accessories	1 Set	---	---
	b) Isolator status indication lamp with all accessories	1 Set	---	---
<b>4</b>	<b>OTHER DEVICES</b>			
	a) PVC Circuit label	2 Nos	2 Nos	2 Nos
	b) Painted Aluminium strip mimic showing the single line diagram	1 Set	1 Set	1 Set
	c) Internally mounted equipments	1 Set	1 Set	1 Set
	d) Label indicating manufacturer's name, PO details , drawing reference number etc,	1 No	1 No	1 No
	e) Annunciation windows with etching, lamps, test/acknowledge /reset push buttons etc.	1 Set	1 Set	1 Set.



## SECTION 9.0 – C & R PANELS

### B. RELAY PANELS:

Sl. No.	Particulars	Quantities		
		1T3	1T1	6T1
<b>1</b>	<b>MAIN PROTECTION RELAYS:</b>			
	a) Triple pole, high speed. Percentage bias relay with high set instantaneous element, suitable for two winding transformers, with universal ratio ICTs	1 Set	1 Set	1Set
	b) Restricted earth fault relay	1 No	1 No	1 No
<b>2</b>	<b>BACK UP PROTECTION:</b>			
	a) Numerical Directional over current and earthfault potentially polarized IDMT relay with builtin LBB protection function (on HV side)	1 No	1 No	1 No
	b) Numerical Directional over current and earthfault potentially polarized IDMT relay with builtin LBB protection function (on MV side)	1 No	---	---
<b>3</b>	<b>AUXILIARY RELAYS:</b>			
	a) Trip circuit supervision relays (HV side) (To be provided in control panel)	2 Sets	2 Sets	2 Sets
	b) Trip circuit supervision relays (MV side) (To be provided in control panel)	2 Sets	2 Sets	2 Sets
	c) Inter tripping relay (To trip both HV & MV side of the transformer)	1 Set	1 Set	1 set
	d) DC supply monitoring relay	1 Set	1 Set	1 Set
	f) Auxiliary relays for Bucholtz trip/alarm, oil temperature high trip/alarm, winding temperature high trip/alarm etc., for HV & MV	As Required		
	g) Other annunciation relay	As Required		
	h) LBB trip relay	As Required		
<b>4</b>	<b>OTHER DEVICES:</b>			
	a) Test terminal block	If required (see Note)		
	b) PVC Circuit labels	2 Nos	2 Nos	2 Nos
	c) Label indicating manufacturers name, PO details, drawing reference, number etc.	1 No	1 No	1 No
	d) Internally mounted equipment's	1 Set	1 Set	1 Set

Note: Refer Note of Annexure CRP – 4, wherever applicable.

**SECTION 9.0 – C & R PANELS****ANNEXURE – CRP-7****CONTROL, METERING AND RELAY PANEL FOR 33KV FEEDERS  
(TYPE 3L-FOR 33KV FEEDER)**

The C & R panel shall generally consist of following items.

**A. CONTROL AND INDICATION PANEL:**

<b>SL. No.</b>	<b>PARTICULARS</b>	<b>QUNATITIES 3L</b>
1	<b>METERING DEVICE</b>	
	a) AC ammeter range 0 to 200 Amp(with transduced for scada operation & monitoring)	3 Nos
	b)Multi functional Meter	1No
	AC 3 phase, 4-wire CT/PT operated electronic trivector meter accuracy 0.2S with ABT & TOD features & DLMS compliant shall confirm to detailed specification furnished	1 No
	c) AC voltmeter	3 Nos (Refer Note)
	d) Test Terminal Block for remote control of 33KV CB	1 No
2	<b>CONTROL DEVICES:</b>	
	a) Control switches for remote control of 33KV CB	1 No
3	<b>INDICATION AND ANNUNCIATION DEVICE:</b>	
	a) CB status indication lamps with Accessories	1 Set
	b) Isolator status indicating lamps with all accessories	2 Sets(Refer Note)
	c) VT indicating lamps	2 Nos (Refer Note)
4	<b>OTHER DEVICE:</b>	
	a) PVC circuit label	2 Nos
	b) Painted aluminium strip, mimic showing the single line diagram	1 Set
	c) Internally mounted equipments	1 Set
	d) Label indicating manufacturer's name, PO details, drawing reference no. etc.,	1 Set
	e) Annunciation windows with etching, lamps, Tests/acknowledgement/reset push buttons etc.,	1 Set

## SECTION 9.0 – C & R PANELS

### B RELAY PANEL:

SL. No.	PARTICULARS	QUNATITIES 3L
1	<b>MAIN PROTECTION RELAYS:</b>	
	a) Numerical Non Directional over current and earthfault IDMT relays, with instantaneous elements	1 No
2	<b>AUXILIARY RELAYS:</b>	
	a) Trip circuit supervision relays (To be provided in the control panel)	2 Sets
	b) Tripping relay	1 Set
	c) DC supply monitoring relay	1 Set
	d) Annunciation relays and other relays	1 Set
3	<b>OTHER DEVICES:</b>	
	a) Test terminal block	If required see note
	b) PVC Circuit labels	2 Nos
	c) Label indicating manufacturer's name, PO Details, drawing reference no. etc.,	1 No
	d) Internally mounted equipments	1 Set

- NOTE:Refer note of Annexure CRP-4, wherever applicable.
- AC Voltmeter & VT indicating lamps to be provided in any one of the feeder panels.

## SECTION 9.0 – C& R PANELS

### ANNEXURE – CRP –9

#### CONTROL, METERING AND RELAY PANEL FOR 110/66KV

##### CAPACITOR BANK

(TYPE 1CB-FOR 110KV CAPACITOR BANK)

(TYPE 6CB-FOR 66KV CAPACITOR BANK)

#### A CONTROL AND INDICATION PANEL:

Sl No.	PARTICULARS	QUANTITIES	
		1CB	6 CB
1	<b>METERING DEVICE</b>		
	a) AC ammeter dual range 0-200/0-400 A	3 Nos	3 Nos
	b) AC MVAR meter with center zero, range in MVAR	1 No 25-0- 25/ 50-0-50	1 No 25-0- 25/ 50-0-50
	c) AC 3 phase, 4-wire CT/PT operated electronic trivector meter accuracy 0.2S with ABT & TOD features & DLMS compliant shall confirm to detailed specification furnished	1 No	1 No
	d) AC Voltmeter	3 Nos 0-150 KV	3 Nos 0-90 KV
	e) Multi functional Meter	1No	1No
	f) Test terminal block	1 No	1 No
	g) Bus VT selector switch	1 No	1 No
2	<b>CONTROL DEVICE:</b>		
	a) Control switch for remote control of 110/66 KV CB	1 No	1 No
	b) Control switch for remote control of 110/66 KV Isolators	2 Nos	2 Nos
3	<b>INDICATION AND ANNUNCIATION DEVICE</b>		
	a) CB status indication lamps with accessories	1 Set	1 Set
	b) Isolator status indicating lamps with all accessories	4 Sets	4 Sets
4	<b>OTHER DEVICE:</b>		
	a) PVC Circuit label	2 Nos	2 Nos
	b) Painted Aluminium Strip, mimic showing the single line diagram	1 Set	1 Set
	c) Internally mounted equipments	1 Set	1 Set

	d) Label indicating manufacturer's name, PO details, drawing reference nos. etc.,	1 No	1 No
	e) Annunciation windows with etching, lamps, test/acknowledgement/reset push buttons etc.,	1 Set	1 Set

#### B. RELAY PANELS:

SI No.	PARTICULARS	QUANTITIES	
		1CB	6 CB
1	<b>BACK UP PROTECTION:</b>		
	a) Non directional over current and earthfault IDMT relay with builtin LBB protection function.	1 Nos	1 Nos.
	c) i) Circulating current relay for neutral displacement ii) Timer relay for the above 0.1 to 1 sec.	1 No 1 No	1 No 1 No
	d) i. Timer relay for Capacitor discharge 0 to 600 sec ii. Auxiliary relay for the above	1 No if required	1 No if required
	e) Over voltage relay setting 100-130%	1 No	1 No
	f) Under voltage relay setting 30-90%	1 No	1 No
	g) PT fuse failure relay	1 No	1 No
2	<b>AUXILIARY RELAYS:</b>		
	a) Trip circuit supervision relays (to be provided in the control panel)	2 Sets	2 Sets
	b) Tripping relay	1 Set	1 Set
	c) DC supply monitoring relay	1 Set	1 Set
	d) Local Breaker back up trip relay	1 No	1 No
	e) Annunciation relays and other relays	As required	As required
3	<b>OTHER DEVICES:</b>		
	a) Test Terminal block	If required see note	If required see note
	b) PVC circuit labels	2 Nos	2 Nos
	c) Label indicating manufacturer's name, PO details, drawing reference number etc.,	1 No	1 No
	d) Internally mounted equipments	1 Set	1 Set

NOTE: Refer notes of annexure CRP-4 Wherever applicable.

## ANNEXURE – CRP –GTP

### SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS OF CONTROL EQUIPMENT AND RELAYS

	<b>Bidder's Name</b>	
<b>Sl. No.</b>	<b>Description</b>	
<b>A.</b>	<b><u>CONTROL &amp; RELAY PANELS :</u></b>	
<b>I</b>	<b>Description, Construction &amp; formation details :</b>	
1	Make and Type reference of manufacturer	
2	Type	
	i) type of construction.(duplex or simplex)	
	ii) type of scheme ( numerical type or static type)	
	a) for line	
	b) for power transformer	
3	Thickness of sheet steel (mm):	
	i. Door, Top and Bottom of panel	
	ii. Other	
4	Tentative overall dimensions (L*B *H) (mm) of each panel	
5	Dead weight of each panel (Kgs)	
6	Approximate weight of each panel with all components (Kgs)	
7	Details of packing for transport	
8	Overall dimensions of transport package (L*B*H) (mm)	
9	Approximate gross weight of transport package (Kgs)	
10	Exterior paint film thickness (microns) and paint colour	
11	Interior paint film thickness (microns) and paint colour	
12	Cubicle Lighting : Volts, wattage, Type of holder and fitting whether provided with door control switch or not.	
13	Safety earthing :	
	a. Material of conductor	
	b. Size (W*T) (mm)	
	c. Surface treatment and finish of conductor.	
	d. Type of end connection	



<b>Sl. No.</b>	<b>Description</b>	
14	Panel front/rear component identity board	
	a. Material	
	b. Size	
	c. Size of lettering and colour	
	d. Method of fixing	
15	Panel wiring :	
	a. Type and material of wire conductors, insulation and voltage grade.	
	b. Conductor cross sectional area or strands/gauge of wire and colour scheme adopted for :	
	i. VT secondary circuits and annunciation circuit.	
	ii. Other Circuits.	
	c. Type of wire termination	
16	Mimic bus details :	
	a. Type painted / strip fixed	
	b. Width (mm)	
	c. Whether colour scheme specified will be followed	
	d. If not specify deviations.	
<b>II.</b>	<b>TERMINAL BLOCKS AND CONNECTORS (USED FOR PANEL WIRING)</b>	
1	Make and Type reference of manufacturer	
2	Insulation and voltage grade	
3	Constructional details	
4	Current rating of studs, size and material	
5	Whether shrouding provided or not	
6	Whether space terminals provided or not	
7	Literature enclosed.	
<b>III.</b>	<b>INDICATING LAMPS :</b>	
1	Wattage and voltage of lamp	
2	Size of lens and material thereof	
3	Type of lamp holder	
4	Whether provided with series resistor? If yes, specify Ohmic value power loss	
<b>IV</b>	<b>FUSE HOLDERS AND FUSES :</b>	
1	Make and Type reference of manufacturer	
2	Insulation and voltage grade	



<b>Sl. No.</b>	<b>Description</b>	
3	Type of Insulation material	
4	Type of fuses	
5	Rating of fuses provided for different circuits	
6	Literature enclosed.	
<b>V</b>	<b>CONTROL SWITCHES FOR ISOLATORS AND CIRCUIT BREAKERS :</b>	
1	Make and Type reference of manufacturer	
2	Type of switch :	
	a. For Isolators and CBs	
	b. Auto re-close	
	c. Transfer Trip	
3	Number of possible positions of the handle for each type of switch.	
	a. No. of contacts available in each position	
	b. Maximum number of contacts which can be accommodated in each position.	
4	Number of lost motion type slip contacts in case of Isolators and CB switches.	
	a. After close	
	b. After trip	
	c. Maximum number of slip contacts possible	
5	Rating of contacts :	
	a. Voltage	
	b. Make and carry continuous current	
	c. Make and carry current for 1 Sec.	
	d. Breaking resistive load current.	
	e. Breaking inductive load current with L/R ratio of 40 milliseconds.	
	f. Type of contacts and surface treatment	
	g. Whether contacts shrouded.	
6	Whether locking arrangement is available	
7	Type of handle and standards, If any, to which it conforms.	
	a. Dimensions	
	b. Mounting details	
8	Whether detailed technical literature and drawings enclosed. (YES/NO)	
<b>Sl. No.</b>	<b>Description</b>	

<b>VI.</b>	<b>SELECTOR SWITCHES :</b>	
1	Make and Type reference of manufacturer	
2	Type of handle / Switch	
3	Mounting details	
4	Number of positions	
5	Number of contracts available in each position.	
	a. Open	
	b. Close	
6	Making capacity of contacts	
7	Breaking capacity of contacts	
8	Whether locking arrangement is available.	
9	Whether detailed literature and drawings enclosed. (YES/NO)	
<b>VII.</b>	<b>PUSH BUTTONS :</b>	
1	Make and Type reference of manufacturer	
2	Mounting details	
3	Type of contact	
4	Current and voltage rating	
5	No. of contacts	
	a. NO	
	b. NC	
6	Whether shrouding provided to prevent inadvertent operation (YES/NO)	
7	Whether provided with integral engraved inscription plates (YES/NO)	
<b>VIII</b>	<b>AUXILIARY CT's VT'S :</b>	
1	Make and Type reference of manufacture	
2	a. Type	
	b. Ratios available	
	c. Burden V A	
	d. Standard to which it conforms	
	e. Accuracy class	
	f. Short time current / voltage rating	
	g. Temperature rise	
	h. One minute power frequency withstand voltage	
	j. Mounting dimensional details	
<b>Sl. No.</b>	<b>Description</b>	

	j. Weight	
	k. Panel in which to be provided with quantity thereof and connected ratio	
3	For CT's only	
	a. Knee point voltage (KPV) (Volts)	
	b. Excitation current at KPV and 50% KPV (ma)	
	c. Internal impedance of primary and secondary windings in ohms	
4	Literature enclosed.	
<b>IX.</b>	<b>SPACE HEATERS :</b>	
1	Make and Type reference of manufacture	
2	Type of space heater (Tubular / strip type)	
3	Rating Wattage	
4	Whether thermostat provided (YES/NO)	
<b>B</b>	<b><u>INDICATING INSTRUMENTS AND METERS :</u></b>	
<b>I</b>	The tenderer shall furnish guaranteed Technical particulars for all types of meters offered, in the following proforma (separate sheet shall be enclosed for each type of meter :)	
1	Make and country of manufacture	
2	Type and rating	
3	Size and weight	
4	Mounting details	
5	Rated VA burden and power consumption (In case of two energising quantities the burden and consumption shall be furnished separately)	
6	Continuous overload rating of current / voltage coil	
7	Short time over load of current coil / potential coil	
8	Accuracy class and grade	
9	Adjustments provided	
10	Whether magnetically shielded (YES/NO)	
11	Details of tropicalisation	
12	Additional features provided	
13	Pointer position center zero / end zero	
14	Whether detailed literature enclosed. (YES/NO)	

<b>Sl. No.</b>	<b>Description</b>	
15	Additional details for watt meter / V A R / Watt Hour Meter	
	a. Whether spare dial plates for different ration being provided.	
	b. Limits of error UPF at 125% and 10% of rated current.	
	c. Limits of error at 0.5 PF lag at 125%, 25% and 10% of rated current.	
16	Additional details for static watt hour meter	
	a. Type of registering mechanism	
	b. Display sequence	
	c. Parameters that can be measured	
	d. Whether the meter can be used to get demand details	
	e. Whether optical readout facility provided	
<b>II</b>	<b>INSTRUMENT TEST TERMINAL BLOCKS :</b>	
1	Make and Type reference of manufacturer	
2	Insulation class and rating	
3	Size and mounting details	
4	Type of CT terminal shorting mechanism (LINK / SCREW)	
5	Type of VT terminal Isolating Mechanism	
6	Whether detailed literatures enclosed. (YES/NO)	
<b>C</b>	<b>GENERAL PROTECTION RELAYS :</b>	
<b>I</b>	The tenderer shall furnish guaranteed Technical particulars for all types of meters offered, in the following proforma (separate sheet shall be enclosed for each type of relay :)	
1	Manufacturer's name or trade marks	
2	Type designation	
3	Size and mounting details (whether in draw out case)	
4	Rated Values of both input and auxiliary energizing quantities	
5	Values of the limits of the operative range(s) of the auxiliary energising quantity (ies)	
6	Contacts data, Number and rating of main and auxiliary contacts	

<b>Sl. No.</b>	<b>Description</b>	
7	Rated value or setting range of the characteristic quantities and or angle	
8	Limiting short-time thermal withstand values	
9	Limiting dynamic values.	
10	i. Burden data ( in case of poly input relays - data shall be furnished for appropriate set of input terminals).	
	a. At highest tap - AC current / voltage coil	
	b. At lowest tap - AC current / voltage (coil)	
	ii. DC power consumption.	
11	Impulse and dielectric test voltage(s)	
12	Details of accessories (If essential to the relay performance)	
13	Details of accessories (Optional items)	
14	Whether provided with seal in trip contacts	
15	a. Type of operating characteristics	
	b. Accuracy of operating characteristics, operating time with details	
16	H.F. disturbance test voltage (s)	
17	Whether literature enclosed	
18	Type of relay flag indicator and rating of target coil	
<b>II</b>	In addition to the above details, the following details shall also be furnished for relays specified below :	
<b>1</b>	<b>DOCR / DEFR :</b>	
	a. Directional sensitivity	
	b. Minimum voltage at which the directional units operate	
	c. Characteristic angle	
<b>2</b>	<b>OVER FLUXING RELAY :</b>	
	a. Whether provided with timer if so time setting available for Alarm and delayed trip.	
<b>3</b>	<b>Distance Protection Scheme for 220KV / 110KV / 66KV Lines:</b>	
A	Type of distance measuring element	
	a. Starting unit	
	i. Type of scheme	
	b. No. of measuring element or comparator with details	

<b>Sl. No.</b>	<b>Description</b>	
	c. Setting range of the distance measurement	
	d. No. of zones	
	i. Overall range for all zones.	
	ii. Reach setting range at rated current.	
	Zone - 1 (forward) - ohms	
	Zone - 2 (forward) - ohms	
	Zone - 3 (forward) - ohms	
	Off set zone 3 reverse - ohms	
	Zone extension (if any)	
	e. Characteristic of each zone	
	Zone - 1	
	Phase fault unit	
	Earth fault unit	
	Zone - 2	
	Phase fault unit	
	Earth fault unit	
	Zone - 3	
	Phase fault unit	
	Earth fault unit	
	Zone - 3 off set	
	Zone -1 in ohms	
	1. Reach of the relay along with characteristic angle at rated current and voltage	
	2. Reach of the relay in resistive direction at rated current & voltage	
	3. Reach in reactive direction at rated current & voltage	
	Zone - 2 in ohms	
	1. Reach of the relay along with characteristic angle at rated current and voltage	
	2. Reach of the relay in resistive direction at rated current & voltage	
	3. Reach in reactive direction at rated current & voltage	
	Zone - 3 in ohms	
	1. Reach of the relay along with characteristic angle at rated current and voltage	

Sl. No.	Description	
	2. Reach of the relay in resistive direction at rated current & voltage	
	3. Reach in reactive direction at rated current & voltage	
	Zone - 3 in Reverse ohms	
	1. Reach of the relay along with characteristic angle at rated current and voltage	
	2. Reach of the relay in resistive direction at rated current & voltage	
	3. Reach in reactive direction at rated current & voltage	
	f. Power swing blocking characteristic setting	
	i. Forward reach	
	ii. Reverse reach	
	g. Setting range of residual compensation	
	h. Setting range of mutual compensation	
	i. (i) Operating time	
	Zone - 1	
	(ii) Time setting range	
	Zone -2	
	Zone -3	
	Power swing blocking	
	j. Accuracy	
	Zone - 1 (reach)	
	Zone - 2 (reach)	
	Zone - 3 (forward reach)	
	K. Polarising scheme	
	Zone - 1	
	Zone - 2	
	Zone - 3	
<b>B.</b>	<b><u>Additional features provided :</u></b>	
	a. Fault locator	
	b. Carrier aided tripping scheme	
	c. Power swing blocking	
	d. Broken conductor detection	
	e. Synchronous check	
	f. Weekend infeed	
	g. Switch on to fault	
	h. Fuse failure supervision	

Sl. No.	Description	
C.	<b><u>Facilities available for Fault Locator</u></b>	
	a. Name and type reference of manufacturer	
	b. Rating and setting available	
	c. Rated V A burden	
	d. Power consumption voltage and current element	
	e. Memory capacity with details	
	f. Triggering method	
	g. Accuracy	
	h. Method of accuracy	
4	Differential protection scheme :	
	a. No. of restraining coils and operating coils.	
	b. Harmonic restraints provided with details	
	c. Rated VA Burden and power consumption of	
	i. Restraining coil	
	ii. Operating coil	
	d. Type of slope setting : If variable, range of slope setting through fault current stability. Maximum & minimum range of HV / MV / LV current ratio over which the relay can be used.	
	e. Whether provided with switching inrush current restraint, if so type.	
<b>III</b>	The tenderer shall confirm whether the following details will be furnished at the time of approval of drawings:	
	a. Identification and location of removable parts.	
	b. Data of permit suitable connection of the relay (including the polarity)	
	c. Data concerning the earthing of metallic part	
	d. To indicate parts of modules which should not be replaced without observing precaution prescribed by the manufacturer.	



<b>GUARANTEED TECHNICAL PARTICULARS ELECTRONIC TRIVECTOR METERS</b>		
<b>Sl. No.</b>	<b>PARTICULARS</b>	
1	Type of Meter	
2	Class of Accuracy	
3	Standard to which the meter conforms	
4	Current rating for which accuracy is guaranteed for	
	a. Basic Current (ib)	
	b. Continuous Current overloading capability	
	c. Short time over current	
	d. Minimum Starting Current	
5	a)Voltage rating for which accuracy is guaranteed for	
	b)Over voltage withstand capacity - continuous	
	c)Voltage Range	
6	Other Parameters for which accuracy is guaranteed	
	a. Reference Temperature	
	b. Standard Reference Frequency (Hz)	
	c. Accuracy Guaranteed for	
	d. Frequency Range	
	e, For single Phase Loads / In- put	
	f. For two Phase Loads / In - put	
	g. For In-put / Loads without neutral in -puts unbalanced Voltages	
	h. Temperature Range	
	i. P F range	
	j. Time	
7	Insulation Resistance	
8	Sampling Plan for measurement of Voltage, Current and Frequency	
9	Power Loss in each Current circuit at Basic Current in VA & WATT	
10	Power Loss in each Voltage circuit at reference in VA & WATT	
11	Display device (Hardware details)	
	a. Type of Display i.e. LCD	
	b. Character size of display digits	

<b>Sl. No.</b>	<b>Description</b>	
	c. No. of Display digits used	
	1. For data	
	2. For parameter identification	
	d. Life of display unit (Guaranteed)	
	e. Method adopted for digit over flow	
12	Display details (Software)	
13	a. Non-volatile memory retention time in absence of power	
	b. Non - volatile memory capacity in KB.	
	c. RAM Capacity	
	d. Maximum number of Parameters which can be stored in non-volatile Memory at each half an hour intervals for Six Months.	
14	Maximum demand	
	a. Parameters that can be dynamically selected	
	b. Integration Period Range	
	c. Provision for Automatic Rest	
	d. Type of MD Computation	
15	Communication Inter-phase available	
	- for calibration	
	- for data transfer	
16	Electro magnetic interference / Electro magnetic comparativity level	
17	Mounting arrangement	
18	Meter sealing arrangement	
	a. Meter body	
	b. Meter terminal block	
	c. MD reset bush button	
	d. Battery unit	
19	Degree of protection against moisture etc.,	
20	a. Provision for real time clock	
	b. Real time clock accuracy	
	c. Life of real time clock (Guaranteed)	
21	Power Supply backup	
22	Measuring principle employed for	
	a. KWH	

<b>Sl. No.</b>	<b>Description</b>	
	b. KVAH	
	c. RKVAH	
	d. Maximum demand parameters	
	e. PF	
NOTE	1. Measuring principle adopted for each of the items above should be specified.	
	2. Measurement logic employed in case of Harmonics and contents up to which meter recognizes for measurement shall be furnished.	
23	Abnormal conditions that will be identified with limiting values	
24	Guarantee period offered for	
	a. Performance and accuracy	
	b. Components not covered under guarantee	
25	Micro processor	
	a. Address in bits	
	b. Sampling rate	
26	Compatibility of the software for the following	
	a. For generation of consumer bill directly with the existing KPTCL billing software	
	b. Compatibility of software provided for MRI, down loading from earlier version already supplied to KPTCL	
	c. Compatibility of software for generation of report for earlier versions	
27	Additional features available	
28	Agreement to furnish protocol details for development of required software through third party	
29	Platform on which the meter communicates	
30	Levels of security	
	a. For changing real time	
	b. For changing display parameters	
	c. For changing Load survey parameters	
	d. For changing TOD Registers, clock setting	
	e. Measuring principle, computation	
31	Specification of reference standard offered	

<b>Sl. No.</b>	<b>Description</b>	
32	Specification of Laptop Computer offered	
33	Specification of MRI kit offered	
34	Specification of equipment offered for checking communication capability through RS232/RS485 port	

**Annexure:**

TECHNICAL SPECIFICATION FOR HT AC 3 PHASE 4 WIRE, CT / PT OPERATED, 1 AMP or 5 AMPS (AS SPECIFIED BY THE PURCHASER), BI-DIRECTIONAL ELECTRONIC TRI-VECTOR METER OF ACCURACY CLASS 0.2S, WITH ABT, TOD FACILITY AND DLMS ICS COMPLIANT SUITABLE FOR 11KV FEEDERS/BULK CONSUMERS/INTER UTILITY POINTS

**Please refer separately uploaded pdf file – “Technical specifications for Energy meters”**