

Technical Specifications for PR No: 6000003096

S.No	Brief Description of the Material	Material Code	Qty
I	132KV/11KV, 16MVA Power Transformer Control & Relay panel	CG3500208681	1 number

TECHNICAL SPECIFICATION FOR POWER TRANSFORMER CONTROL & RELAY PANEL

S.No	Brief Description of the Material	Requirement	Vendor to Confirm/Specify	Remarks
1	One Number 132KV/11KV Power Transformer Control & Relay panel is required for Power Transformer HV & LV feeder of 132/11KV, 16 MVA Transformer located at TSTRANCO substation ,BHEL R.C.Puram.	The below contains technical specification of the above equipment. It is not the intent to specify completely herein all details of the design and construction of equipment. However, the equipment shall conform in all respects to high standards of engineering, design and workmanship and shall be capable of performing in continuous Operation in TSTRANSCO substation. The equipment offered shall be complete with all components necessary for its effective and trouble free operation in TSTRANSCO Substation.	Vendor to confirm	
2	Standard	IS 3231/IEC255/ BS142/ IS 1248/ IS 2419/ BS 89/ IS 13010/ IS 722/ IEC 521/ BS 3T/ IS 375/ IS 8686/ IEC 255 / IEC 801-4 with latest amendments	Vendor to confirm	
3.	Transformer, CT, PT details	Details provided below in Annexure-A	Vendor to confirm	
3.	Control and Relay panel	the panel should be as per the details provided	Vendor to confirm.	

		below in Annexure-A in clause 2.1.0 and 2.1.1		
4.	Panel Mounting	the panel should be as per the details provided below in Annexure-A in clause 2.1.2	Vendor to confirm.	
5.	Panel Internal wiring and other accessories	the panel should be as per the details provided below in Annexure-A in clause 2.1.3	Vendor to confirm.	
6.	Terminal Blocks	should be as per the details provided below in Annexure-A in clause 2.1.4	Vendor to confirm.	
7.	Painting	should be as per the details provided below in Annexure-A in clause 2.1.5	Vendor to confirm.	
8.	Mimic Diagram	should be as per the details provided below in Annexure-A in clause 2.1.6	Vendor to confirm.	
9.	Earthing	should be as per the details provided below in Annexure-A in clause 2.1.9	Vendor to confirm.	
10.	Name Plates and Marking	should be as per the details provided below in Annexure-A in clause 2.1.7	Vendor to confirm.	
11.	Miscellaneous Accessories and Supporting steel	should be as per the details provided below in Annexure-A in clause 2.1.8	Vendor to confirm.	
12.	Instruments and Meters	should be as per the details provided below in Annexure-A in clause 2.1.10	Vendor to confirm.	
13.	Relays	should be as per the details provided below in Annexure-A in clause 2.1.11	Vendor to confirm.	
14.	Annunciation System	should be as per the details provided below in Annexure-A in clause 2.1.12	Vendor to confirm.	
15.	Switches	should be as per the details provided below in Annexure-A in clause 2.1.13	Vendor to confirm.	

16.	Indicating lamps	should be as per the details provided below in Annexure-A in clause 2.1.14	Vendor to confirm.	
17.	Position Indicators	should be as per the details provided below in Annexure-A in clause 2.1.15	Vendor to confirm.	
18.	Trip Circuit Supervision relay	should be as per the details provided below in Annexure-A in clause 2.1.16	Vendor to confirm.	
19.	High Speed Tripping relay	should be as per the details provided below in Annexure-A in clause 2.1.17	Vendor to confirm.	
20.	Flags	should be as per the details provided below in Annexure-A in clause 2.1.18	Vendor to confirm.	
21.	Numerical Differential protection	should be as per the details provided below in Annexure-A in clause 3.1(a)	Vendor to confirm.	
22.	Over fluxing relay protection (Numerical)	should be as per the details provided below in Annexure-A in clause 3.1(b)	Vendor to confirm.	
23.	Backup over current and earth fault protection (Numerical)	should be as per the details provided below in Annexure-A in clause 3.1(c)	Vendor to confirm.	
24.	Auxiliary relays	should be as per the details provided below in Annexure-A in clause 3.1(d)	Vendor to confirm.	
25.	Numerical Local Breaker Backup Protection	should be as per the details provided below in Annexure-A in clause 3.1(e)	Vendor to confirm.	
26.	Numerical under voltage relay scheme	should be as per the details provided below in Annexure-A in clause 3.1(f)	Vendor to confirm.	

Annexure- A

1) PRINCIPAL PARAMETERS :

(a) 16 MVA TRANSFORMER:

The details of terminal equipment for 16 MVA, 132/11 kV Power Transformer are given below:
132 kV Side CTs (HV CTs) Ratio:150-100-50/1-0.5775, 1-1A

Core No.	Accuracy class	Burden	Minimum knee point voltage	Purpose
1.	5P 20	50 VA	-	O / L & E / L Protection
2.	PS	-	Vk = 450 V Rct < 5 Ohms Im < 10mA @Vk/2	Transformer Differential protection
3.	0.2S	5 VA	-	Metering

(b) Breakers for HV side of 16 MVA, 132/11 kV Transformer

No. of poles : 3
Rating of closing : 220 V DC, 260 Ohms, 600 Watts
coil and trip coil

(c) 11 kV side CTs (LV CTs) Ratio : 1200-800/1-0.5775,1-1A

Core No.	Accuracy class	Burden	Minimum knee point voltage	Purpose
1.	5 P 20	15 VA	-	O / L & E / L Protection
2.	PS	-	Vk=450V Rct < 5 ohms Im< 10mA @ Vk/2	Transformer Differential protection
3.	0.2	10 VA	-	Metering

(d) Circuit breakers:

i) 132 KV and 11 KV feeder breakers:

132 KV SF6 breakers having 3 Nos. breaker poles suitable for 3 phase re-closing will be used as 132 kV feeder breakers.

Each Pole 132 KV breaker is provided with 2 sets of trip coils.

Each 11 KV breaker is provided with 2 sets of trip coils.

The details of breakers are given in the Table below:

Sl. No.	Details	132 kV SF6 Breaker	11 kV Vacuum Circuit Breaker
1.	Highest System Voltage	145 KV	12 KV
2.	Breaking Capacity	31.5 KA	25 KA
3.	Total Break Time at 10% rated } interrupting capacity }	< 5 cycles	< 5 cycles
4.	Make time	Not exceeding 150 ms	
5.	Minimum re-closing time at full rated interrupting capacity from the instant of trip coil energisation.	300 ms	300 ms
6.	Minimum dead time 3 phase re-closing	300 ms	300 ms
7.	Type of closing	Spring	Spring
8.	Trip coil and close coil rating	220 V DC 600 Watts	220 V DC 600 Watts

2.0 GENERAL TECHNICAL REQUIREMENTS:

2.1.0 Control & Relay panels: Detailed description:

The control and relay panel shall consist of a vertical front panel with equipment mounted thereon and having wiring access from the rear. It shall have double leaf door with lift off hinges at the back for panels of width more than 800 mm. Doors shall have handles with built-in locking facility.

2.1.1 Constructional Features:

a) It is the responsibility of the vendor to ensure that the equipment specified and such unspecified complementary equipment required for completeness of the protective/control schemes be properly accommodated in the panels without congestion and if necessary provide panels with larger dimensions. No price increase at a later date on this account shall be allowed.

b) 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-55 in accordance with IS:2147.

c) Panels shall be free standing, floor mounting type and shall comprise structural frames enclosed completely with specially selected smooth finished, cold rolled sheet steel of thickness not less than 3 mm for weight bearing members of the panels such as bass frame, front sheet and door frames, and 2.0 mm for sides, door top and bottom portions.

d) 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.

e) Design, materials selection and workmanship shall be such as to result in neat appearance inside and outside with no welds, rivets or bolt head apparent from outside, with all exterior surfaces true and smooth.

f) All necessary anchor bolts and other materials required for foundation of panels shall be supplied.

g) Cable entries to the panel shall be from the bottom. The plates of the panel shall be fitted with removable gland plates for fixing the cable glands. Necessary number of cable glands of sizes to suit owner's external cables to the panels. Cable glands shall be screwed type, and shall be suitable for PVC cables. Cable gland plate fitted in the bottom of the Panel shall be connected to the earthing Panel/Station through a flexible braided copper conductor rigidly.

h) Relay panels of modern, modular construction would also be acceptable.

i) The panels shall have suitable width required for mounting of all the equipments on the front panel.

j) The panels shall match with the existing panels in TSTRANSCO's Sub-stations, Matching includes height, depth of the panels, Colour matching and mimic matching and arrangement of equipment on the front.

2.1.2 Mounting

a) All equipment on and in panels shall be mounted and completely wired to the terminal blocks ready for external connection. The equipment on front of panel shall be mounted flush.

b) 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 shall be clearly visible.

c) The vendor shall carry out cutouts, mounting and wiring of the free issue items supplied by others, if any which are to be mounted in this panel in accordance with the corresponding equipment manufacturer's drawings. Cutouts if any, provided for future mounting of equipment shall be properly blanked off.

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

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

f) No equipment shall be mounted on the doors.

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

2.1.3 Panel Internal Wiring and other Accessory Equipment :

- a) Panels shall be supplied completely with interconnecting wiring provided between all electrical devices mounted and wired in the panels and between the devices and terminal blocks for the devices to be connected to equipment outside the panels. When panels are arranged to be located adjacent to each other all inter panel wiring and connections between the panels shall be furnished and the wiring shall be carried out internally.
- b) All wiring shall be carried out with 1100 V grade, single core, multi stranded copper conductor wires with FRLS PVC insulation and shall be heat resistant grade and vermin and rodent proof. The minimum size of the stranded copper conductor used for internal wiring shall be as follows:
 - i) All circuits except current transformer circuits one multi strand 1.5 sq.mm per lead
 - ii) Current transformer circuit: one 2.5 sq.mm per lead. The minimum number of strands per conductor shall be three.
- c) All internal wiring shall be securely supported, neatly arranged, readily accessible and connected to equipment terminals and terminal blocks. Wiring gutters and troughs shall be used for this purpose.
- d) Auxiliary bus wiring for AC and DC supplies, voltage transformer circuits, annunciation circuits and other common services shall be provided near the top of the panels running throughout the entire length of the panels.
- e) Wire termination shall be made with solderless crimping type and tinned copper lugs which firmly grip the conductor and insulation. Insulated sleeves shall be provided at all the wire terminations. Engraved core identification plastic ferrules marked to correspond with panel wiring diagram shall be fitted at both ends of each wire. Ferrules shall fit tightly on the wire and shall not fall off when the wire is disconnected from terminal blocks.
- f) All wires directly connected to trip circuit breaker or device shall be distinguished by the addition of red coloured unlettered ferrule. Numbers 6 and 9 shall not be included for ferrule purposes.
- g) Longitudinal troughs extending throughout the full length of the panel shall be preferred for inter panel wiring. Interconnections to adjacent panel shall be brought out to a separate set of terminal blocks located near the slots or holes meant for taking the inter connecting wires. Arrangements shall permit easy inter connections to adjacent panels at site and wires for this purposes shall be provided by vendor looped and bunched properly inside the panel.
- h) vendor shall be solely responsible for the completeness and correctness of the internal wiring and for the proper functioning of the connected equipment

2.1.4 Terminal Blocks

- a) All internal wiring to be connected to the external equipment shall terminate on terminal blocks preferably vertically mounted on the side of each panel. Terminal blocks shall be 1100V grade and have 10 Amps continuous rating moulded piece complete with insulated barriers, stud type terminals, washers, nuts and lock nuts. Terminal block design shall include a white fiber markings strip with clear plastic slip-on/clip-on terminal covers. Markings on the terminal strips shall correspond to wire number and terminal numbers on the wiring diagrams.

- b) Terminal blocks for current transformer and voltage transformer secondary leads shall be provided with test links and isolating facilities. Also current transformer secondary leads shall be provided with short circuiting and earthing facilities.
- c) At least 20% spare terminals shall be provided on each panel and these spare terminals shall be uniformly distributed on all terminal blocks.
- d) Unless otherwise specified, terminal blocks shall be suitable for connecting the following conductors of purchaser's cable on each side:
 - i) All circuits except current transformer circuits: minimum of one of 2.5 sq.mm copper
 - ii) All CT circuits: minimum of two of 2.5 mm square copper and all PT circuits minimum of four of 2.5 sq.mm copper
- e) There shall be a minimum clearance of 250 mm between the first row of terminal blocks and associated cable gland plate. Also the clearance between two rows of terminal blocks shall be minimum, of 150 mm.
- f) Arrangement of the terminal block assemblies and the wiring channel within the enclosure shall be such that a row of terminal blocks is run parallel and in close proximity along each side of wiring duct to provide for convenient attachment of internal panel wiring. The side of the terminal block opposite the wiring duct shall be reserved for purchaser's external cable connection. An adjacent terminal block shall also share this field wiring corridor. A steel strip shall be connected between adjacent terminal block rows at 450 mm intervals for support of incoming cables.
- g) The number and sizes of the Purchaser's multi-core incoming cable will be furnished by bidder for necessary procurement from our end. All necessary cable terminating accessories such as gland plates, glands, crimp type tinned copper lugs supporting clamps and brackets, wiring troughs and gutters etc. shall be supplied by bidder.

2.1.5 Painting

- a) All sheet steel work shall be phosphated in accordance with the IS:6005 "Code of practice for phosphating iron and steel"
- b) Oil, grease, dirt and sweat shall be thoroughly removed by emulsion cleaning.
- c) Rust and scale shall be removed by picking with dilute acid followed by washing with running water rinsing with a slightly alkaline hot water and drying.
- c) After phosphating thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and oven drying.
- e) 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 the second coat shall be stoved.
- f) After application of the primer, two coats of UV protected epoxy paint shall be applied, each coat followed by stoving. The second finishing coat shall be applied after completion of tests. The exterior Colour of the paint shall be selected by the purchaser at a later date.
- g) Each coat of primer and finished paint shall be of a slightly different shade to enable inspection of the painting.

h) A small quantity of finished paint shall be supplied for minor touching up required at site after installation of the panels.

2.1.6 Mimic Diagram

a) Coloured mimic diagram and symbols showing the exact representation of the system shall be provided in the front of control panels.

b) Mimic diagram shall be made preferably of anodized aluminum or plastic of approved fast Colour material which shall be screwed on to the panel and can be easily cleaned. Painted overlaid mimic is also acceptable. The mimic bus shall be 2 mm thick. The width of the mimic bus shall be 10 mm for bus bars and 7 mm for other connections.

c) Mimic bus Colour will be decided by the Purchaser and shall be obtained from the Purchaser by the successful Bidder.

d) When semaphore indicators are used for isolator position they shall be so mounted in the mimic that the isolator closed position shall complete the continuity of mimic.

e) Indicating lamp, one for each phase for each bus shall be provided on the mimic to indicate bus charged condition.

2.1.7 Name plates and markings:

a) All equipment mounted on front and rear side as well as equipment mounted inside the panels shall be provided with individual name plates with equipment designation engraved. Also on the top of each panel, on front as well as rear side, large and bold name plates shall be provided for circuit/feeder designation.

b) All front mounted equipment shall be also provided at the rear with individual name plates engraved with tap numbers corresponding to the one shown in the panel internal wiring to facilitate easy tracing of the wiring. The name plates shall be mounted directly by the side of the respective equipment in a visible manner and shall not be hidden by the equipment wiring.

c) Name plates shall be made of non-rusting metal. Name plates shall be black with white engraving lettering. The name plates inscription and size of name plates and letters shall be submitted to the Purchaser for approval.

d) Each instrument and meter shall be prominently marked with the quantity measured e.g. kV, A, MW, etc. All relays and other devices shall be clearly marked with manufacturer's name, manufacturer's type, serial number and electrical rating data.

e) Each switch shall bear clear inscription, identifying its function eg. "BREAKER" "AMMETER" etc., similar inscriptions shall also be provided on each device whose function is not otherwise identified. If any switch device does not bear this inscription separate name plate 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-N-OFF" etc.,

2.1.8 Miscellaneous Accessories and Supporting Steel:

a) Plug point-A AC 240 Volts, single phase, 50 HZ AC plug point shall be provided in the interior of each cubicle with "ON-OFF" Switch for connection of hand lamps.

b) Interior lighting: Each panel shall be provided with a fluorescent lighting fixture rated for 240 volts, single phase, 50 HZ supply for the interior illumination of the panel during maintenance. The fittings shall

be complete with switch fuse unit and switching of the lighting shall be controlled by the respective panel door switch.

c) Each control panel shall be provided with necessary arrangements for receiving, distributing, isolating and fusing of DC and AC supplies for various control signaling, lighting and space heater circuits. MCBs for the incoming circuits and fuses for sub-circuits shall be provided. Selection of the main and sub-circuit fuse rating shall be such as to ensure selective clearance of sub-circuit faults. Fuses shall protect potential circuit for relaying and metering. All fuses shall be HRC cartridge type conforming to IS:2208 mounted on plug-in type fuse bases. All accessible live connection to fuse bases shall be adequately shrouded. Fuses shall have operation indicators for indicating blown fuse condition. Fuse carrier base shall have imprints of the fuse rating and voltage.

d) Supporting steel: All necessary foundation anchor bolts and other parts of supporting and fastenings, of the panels shall be supplied by the vendor.

2.1.9 Earthing:

a) All panels shall be equipped with an earth bus securely screwed. Location of earth bus shall ensure no radiation interference for earth systems under various switching conditions of isolators and breakers. The material and the sizes of the bus bar shall be atleast 25 X 6 mm copper flat. When several panels are mounted adjoining each other, the earth bus shall be made continuous and necessary connectors and clamps for this purpose shall be included in the scope of supply of contractor. Provision shall be made for extending the earth bus bars to future adjoining panels on either side.

b) Provision shall be made on each earth bus bars of the end panels for connecting Purchaser's earthing grid. Necessary terminal clamps and connectors for this purpose shall be included in the scope of supply of contractor. The wire or screens should be clearly bonded and earthed at the gland plate.

c) All metallic cases of relays, instruments and other panel mounted equipment shall be connected to the earth bus preferably by independent copper wires of size not less than 2.5 sq.mm. The colour code of earthing wires shall be green. Earthing wire shall be connected on terminals with suitable clamp connectors and soldering shall not be permitted.

d) VT and 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.

2.1.10 Instruments and Meters:

a) All instruments, meters, recorders and transducers shall be enclosed in dust proof, moisture resistant, cases and shall be suitable for tropical use – IP 65 protected. They shall be calibrated to read directly the primary quantities. They shall be accurately adjusted and calibrated at works and shall have means of calibration, check and adjustment at site. All accessories including test switches and test plugs, where applicable shall be furnished. Their elements shall be shock resistant and shielded from external magnetic fields.

b) Indicating Instruments: Digital instruments shall have digital display of not less than 25mm (height)

i) Unless otherwise specified all electrical indicating instruments shall be of 96sq. mm size . They shall be suitable for flush mounting.

- ii) The dial shall be free from warping, fading and discoloring. The dial shall also be free from parallax error.
- iii) Instruments shall conform to IS:1248 and shall have accuracy class of 1.0 or better. The design of the scales shall be such that it can read to a resolution corresponding to 50% of the accuracy class index.
- iv) Instrument covers shall be of shadow proof design, utilising all available light. The indicating instruments shall have red marks on the dial corresponding to rated values of the associated primary equipment.
- v) Ammeters and current coils of watt meters and var meters shall continuously withstand 120% of rated current and 10 times the rated current for 0.5 sec. without loss of accuracy. Voltmeters and potential coils of watt meters and var meters shall withstand 120% of rated voltage for 0.5 seconds without loss of accuracy.

C) Metering Instruments:

1. Ammeter: Shall be installed at both HV & LV side for necessary measurement.
Ammeter shall be of digital type and provided with direct reading double range scale. Scale value of ammeters shall be equal to 1 to 1.3 times the rated primary current of the current transformer feeding it. The rated current shall be 1.0 Amp. Accurate reading of ammeter shall be possible at the lowest limit of 5% of the rated current.
2. Voltmeter: Shall be installed at both HV & LV side for necessary measurement.
Voltmeter shall be digital type. Rated voltage shall be $110/\sqrt{3}$ Volts.
Maximum value of voltage scale shall be 20% in excess of the normal voltage.
3. Wattmeter: Shall be installed at both HV & LV side for necessary measurement.
Wattmeter shall be suitable for indicating flow of power in both directions and shall be of 2 elements type for use in 3 phase 3 wire unbalanced system or 3 element type for 3 phase 4 wire unbalanced system. Current coil shall be rated at 1 A and the voltage coil for 110 volts.
4. Energy Meter: Electronic Trivector meter Shall be installed at both HV & LV side for necessary measurement.
Electronic Trivector meter shall be static type conforming to IEC 687 and suitable for bi-directional power flow and for CT/CVT or IVT connection. The static meter shall measure active and reactive energy both import and export, by 3 phase 4 wire principle suitable for balanced/unbalanced 3phase load. The active and reactive energy shall be directly computed in CT & VT primary values and stored in four different registers as KWH (E), KWH(I), KVARH(E) and KVARH(I) along with a plus sign for export and minus sign for import. CT secondary is 1 A, PT secondary is $110/\sqrt{3}$ V. Meters shall compute the energy sent out/received, from/to the station bus bar during each successive 15 minute block and store in the respective registers. Meter shall display on demand the energy sent out/received during the previous 15 minute block. Further the meter shall continuously integrate the energy readings of each register upto that time. All these readings shall be displayed on demand. Cumulative reading of each register shall be stored in non-volatile memory at the end of each hour of day starting from 01 hours. These readings shall be stored for a period of 35 days before being erased. The meter shall have built in clock and calendar having an accuracy of 1 minute per month or better. Date/time shall be displayed on demand. Meter shall have communication interface via (i) optical port conforming to IEC 1107 Protocol/ANSI/PACT for data retrieving through Common Meter Reading Instrument (CMRI) and (ii) RS 485 Port for remote communication.

Each meter shall have a unique identification code provided by purchaser and shall be marked permanently on the front and also on the non-volatile memory. The voltage monitoring of all the three voltages shall be provided. An automatic back up shall be provided by a built in life time battery and shall not need replacement for at least ten years with a continuous VT interruption of even two years. Date and time of VT interruption and restoration shall be automatically stored in non-volatile memory. The meter shall have an optical port at the front of the meter for data collection by a hand held device and RS 485 port for remote communication. The meter shall conform to open protocol modem for remote communication.. The meter shall have pulse outputs to test KWH and KVARH accuracy and for connecting it to time of day tariff equipment.

5. Frequency meter : Frequency meter shall be provided on HV side for necessary indication.

6. KVAR meter : KVAR meter shall be provided on both HV & LV side.

7. Load Manager : Load Manager shall be provided on both HV & LV side. Load manager shall have communication interface through RS 485 Port for remote communication.

2.1.11 Relays:

a) All relays shall conform to the requirements of IS:3231 or other applicable approved standards.

Relays shall be suitable for flush or semi flush mounting on the front with connections from the rear. Relays shall be rectangular in shape and shall have dust tight, dull black or egg shell black enamel painted cases with transparent cover removable from the front.

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 bid. Necessary test plugs shall be supplied loose and shall be included in Contractor'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 50Hz AC Voltage operated relays shall be suitable for 110volts VT secondaries and current operated relays for 1 Amp CT secondaries as specified in this specification.

DC auxiliary relays and timers shall be designed for 220 V DC voltage and shall operate satisfactorily between 70% and 110% of rated voltage. Voltage operated relays shall have adequate thermal capacity for continuous operation.

d) 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 of circuits etc., and also required for the complete protection schemes described in the specification shall be provided.

All protective relays shall be provided with atleast 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 cases shall have adequate number of

terminals for making potential free external connections to the relay coils and contacts including spare contacts. Relay case size shall be so chosen as not to introduce any limitations on the use of available contacts on the relay due to in-adequacy of terminals.

e) 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, provided 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 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 bucholz relays, temperature protection, fire protection etc.

f) Timers shall be of the electromagnetic or solid state type. Pneumatic timers are not acceptable. Short time delays in terms of milliseconds may be obtained by using copper slugs on auxiliary relays. In such case it shall be ensured that the continuous rating of the relay is not affected. Time delay in terms of milliseconds obtained by the external capacitor resistor combination is not acceptable.

g) No control relay which shall trip the power circuit breaker when the relay is de-energized shall be employed in the circuits.

h) Provision shall be made for easy isolation of trip circuits of each relay for the purpose of testing and maintenance.

i) All relays shall withstand a test voltage 2.5 kV, 50 HZ, rms voltage for one second.

j) 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-unit shall be sufficiently shorter than that of the trip coil or trip relay in series with which it operates to ensure definite operation of the flag indicator of the relay.

ii) Seal-in-unit shall obtain adequate current for operation when one or more relays operate simultaneously.

iii) Impedance of the seal-in-unit shall be small enough to permit satisfactory operation of the trip coil on trip relays when the DC supply voltage is minimum.

k) All protective relays and alarm relays shall be provided with one extra isolated pair of contacts wired to terminals exclusively for Purchaser's use.

l) The following requirements shall be met with in General:

i) The printed circuit cards shall be of fiberglass type and the contact shall be gold plated. All connections with the connector pegs shall be through wire wrapping. All solder joints on the printed circuit boards shall be encapsulated or covered with varnish.

ii) The components shall be rated to carry at least twice the normal expected loads. The resistors 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. The relays must withstand the requirements of IEC 255-4 appendix-E class III regarding HF disturbance tests; IEC 255-4 regarding impulse test at 5 kV and fast transient test as per IEC 801-4. Insulation barriers shall be provided to ensure that transients present in CT & VT connections due to extraneous sources do not cause damage to static circuits.

iii) All relays shall be designed for satisfactory performance under tropical and humid conditions specified in the specification. Special mention shall be made in the technical deviations schedule of the bid for those relays, if any, that Bidder proposes to use which differ from specified requirements.

iv) All devices required for correct operation of each relay shall be provided by supplier without any extra cost.

v) The supplier shall ensure that the terminals of the contacts of the relays are readily brought out for connections as required in the final approved scheme. The type of relay case size offered shall not create any restrictions on the availability of the contact terminals for wiring connections.

vi) AC/DC converter shall be provided in the protective relay wherever necessary in order to provide a stable auxiliary supply for relay operation. Provision of DC cells in the protective relays as reliable standby power supply will however not be acceptable.

vii) The relays shall be stable and suitably protected against transient/induced over voltages and noise signals.

viii) All equipment shall be of modular construction and the modules and sub units shall be of plug in type for easy replacement. The design shall permit fast recognition of defects and facilitate easy repair.

ix) The bidder shall include in his bid a list of installations where the relays quoted have been in satisfactory operation.

2.1.12 Annunciation System:

a) Alarm annunciation system shall be provided for the control board by means of visual and audible alarm in order to draw the attention of the operator to the abnormal operating conditions or the operation of some protective devices. The annunciation equipment shall be suitable for operation with 220 V DC voltage.

b) The visual annunciation shall be provided by annunciation facia, mounted flush on the top of the panels. The audible alarm shall be provided by alarm buzzer and bell for trip and non-trip alarm respectively.

c) The annunciator facia shall be provided with translucent plastic window for alarm point with minimum size of 35 mm x 50 mm. The facia plates shall be engraved in black lettering with respective inscriptions which will be furnished to the Bidder by the Purchaser.

Alarm inscriptions shall be engraved on each window in not more than three lines and size of the lettering shall not be less than 5mm.

d) Facia Windows shall be illuminated with LEDs. 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 and wattage of the lamps provided in the facia windows shall be adequate to ensure clear visibility of the inscriptions in the control room having high illumination intensity (500 Lux), from the location of the Operator's desk.

e) TRIP AND NONTRIP facia shall be differentiated. All TRIP shall have red colour and all NONTRIP facia shall have white colour.

f) Sequence of operation of the annunciator shall be as follows:

Alarm condition	Fault contact	Visual Annunciation	Audible Annunciation
1. Normal	Open	Off	Off
2. Abnormal	Close	Flashing	On
3. Acknowledge push button is pressed	Close	Steady on	Off
4. Reset push button is pressed	Close/Open	On/Off	Off
5. Lamp test push button pressed	Open	Steady on	Off

g) 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 volts AC supply with separate fuses. On failure of the power supply to the annunciation system for more than 3 secs. (adjustable setting) an indicating lamp shall light up and a bell shall sound. A separate push button shall be provided for cancellation of this audible alarm alone but the indicating lamp 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.

h) A separate voltage check relay shall be provided to monitor the failure of supply (240 V AC) to the scheme mentioned above. 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:

i) The annunciation system shall be capable of catering to all simultaneous signals at a time.

ii) 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 supply failure monitoring circuit shall also 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.

iii) One set each of the following push buttons shall be provided on each panel

a) Reset push button for annunciation system

b) Accept push button for annunciation system

iv) 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 15 milli secs.

v) The annunciator shall be suitable for 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" and vice versa.

vi) Micro Processor based alarm and annunciation relay schemes are preferable.

2.1.13 Switches:

a) Control and Instrument switches shall be rotary operated type with plates 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 as per clause 6.8 shall be provided as on aid switch identification.

b) The selection of operating handles for the different types of switches shall be as follows:

- | | | | |
|----|-------------------------------|---|---------------------------------|
| a) | Breaker and isolator switches | : | Pistol grip, black |
| b) | Selector switches | : | Oval or knob, black |
| c) | Instrument switches | : | Round, knurled, black |
| d) | Protecting transfer switch | : | Pistol grip, lockable and black |
| e) | Synchronising switches | : | Oval, Black, keyed handle |

c) The control switch of breaker and isolator shall be of spring return to neutral type. The spring return type shall be provided with target which shall indicate the last operation of the 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" positions respectively.

d) 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. They shall be of 5 position type viz R-Y-B-N-Off. Voltmeter transfer switches for AC shall be suitable for reading all line-to-line and line-to-neutral voltages for non effectively earthed systems and for reading all line to line voltages for effectively earthed systems.

e) Synchronising switches shall be maintained contact (stay put) type. These switches shall be arranged to connect the Synchronising equipment when turned to the "ON" position. One contact of each switch shall be connected in the closing circuit of the respective breaker so that the breaker cannot be closed until the switch is turned to the "ON" position.

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

g) The contacts of all switches shall preferably open and close with snap action to minimise arcing. Contacts of switches shall be spring assisted and contact faces shall be with rivets of pure silver. Springs shall be used as current carrying parts.

2.1.14 Indicating Lamps:

a) Indicating lamps shall be LED type panel mounting with rear terminal connections. Lamps shall have translucent lamp covers to diffuse lights coloured red, green, amber, clear white or blue as specified. The lamp cover shall be preferably of screwed type, un-breakable and moulded from heat resisting material.

b) Bulbs and lenses shall be interchangeable and easily replaceable from the front of the panel. Tools, if required for replacing the bulbs and lenses shall also be included in the scope of supply.

c) The indicating lamps shall withstand 120% of rated voltage on a continuous basis.

2.1.15 Position Indicators:

- a) Position indicators of 'SEMAPHORE' type shall be provided when specified as part of the mimic diagrams on panels for indicating the position of circuit breakers, isolating/ earthing switches etc. The indicator shall be suitable for semi-flush mounting with only the front disc projecting out and with terminal connection from the rear. Their strips shall be of the same colour as the associated mimic.
- b) Position indicator shall be suitable for either AC or DC operation as specified. When the supervised object is in the closed position, the pointer of the indicator shall take up a position in line with the mimic bus bars, and at right angles to them when the object is in the open position. When the supply failure to the indicator occurs, the pointer shall take up an intermediate position to indicate the supply failure.
- c) The position indicators shall withstand 120% of rated voltage on a continuous basis.

2.1.16 Trip circuit supervision relays:

- a) Trip circuit shall be supervised by means of relays. The scheme shall continuously monitor each trip coil in both pre-close and after-close of the breaker. The scheme shall detect. i) Failure of DC supply to each trip coil. ii) Open circuit of trip circuit wiring and iii) Failure of mechanism to complete the tripping operation.
- b) Also 2 Nos. indicating lamps to act in conjunction with trip circuit supervision relays for healthy trip indication of 2 sets of trip coils shall be supplied.
- c) Necessary external resistors for trip circuit supervision relays shall be supplied.

2.1.17 High speed tripping relay shall.

- i) be instantaneous (operating time not to exceed 10 milli seconds)
- ii) be DC operated
- iii) have adequate hand resetting type contacts, preferably operated by push button. The resetting time shall be within 20 milli seconds for self resetting relays.
- iv) have necessary supervisory relays
- v) be provided with operation indicators for each element/coil.
 - ii) have adequate contacts to meet entire requirement of the scheme, with two spare contacts.

2.1.18 Flag relays shall have

- i) Hand reset flag indication
- ii) Two elements
 - iii) Have necessary NO/NC contacts for each element/coil to meet scheme requirements.

3.0 DETAILED DESCRIPTION OF PROTECTIONS:

The protection, auxiliary relay and timers and other equipment that are required to be provided. The detailed description of each protection and the associated equipment is described below:

The setting ranges of relays given in specification are indicative. The setting ranges of the equipment offered, if different from the ones specified, shall also be acceptable if they meet the functional requirements.

The bidder shall quote the protection equipment meeting the following requirements.

3.1 16 MVA,132/11KV POWER TRANSFORMER

NOTE :- 16MVA, 132/11 KV Power Transformer

a) Numerical Differential protection:

It shall be / shall have

- i) triple pole high speed percentage biased differential type.
- ii) an operating time not more than 35 milli secs. at 5 times operating current setting of 20%.
- iii) three instantaneous high set over current units
- iv) second harmonic restraint feature and fifth harmonic by pass /restraint feature and also be stable under normal over fluxing conditions
- v) an operating current setting of 20% or less
- vi) suitable for rated current of 1 Ampere
- vii) adjustable bias setting range of 20% to 50%
- viii) two bias windings per phase
- ix) stable on heavy through faults
- x) include necessary separate interposing CTs for angle and ratio correction or have internal features in the relay to take care of angle and ratio correction.

b) Over fluxing relay protection (Numerical)

It shall be/ shall have

- i) Operate on the principle of voltage to frequency ratio
- ii) Inverse time characteristics compatible to transformer over fluxing withstand capability
- iii) Provide an independent alarm with the time delay continuously adjustable between 0.5 to 60 seconds at a value of V/F adjustable between 100% to 125% of rated value.
- iv) Tripping time shall be governed by V/F Vs Time characteristic of the relay
- v) An accuracy of operating time better than +10%
- vi) Resetting ratio of 98% or better
- vii) Have a set of characteristics for various time multiplier settings. Maximum operating time for the relay shall not exceed 3 and 1.5 seconds at V/F values of 1.4 and 1.5 times rated value, respectively.
- ix) For 132/11 kV Transformer Protection Over fluxing relay shall be provided only on HV side.

c) Backup over current and earth fault protection on 132 KV & 11 KV side of 16MVA Power Transformer of numeric type.

Triple pole non-directional IDMT over current relay with instantaneous high set unit shall be provided for backup over current protection on the HV & LV side. The high set instantaneous units shall have suitable settings. For faults on the HV & LV side involving heavy fault currents the high set units shall clear the faults instantaneously.

Directional IDMT E/F relay with high set instantaneous unit with suitable settings shall be provided for backup protection on the HV side. Separate Earth fault relay with high set unit shall be provided on LV side. Separate high speed trip relay and Trip circuit supervision relay shall be provided for HV & LV protection.

d) Auxiliary relays for transformer protection devices:

Auxiliary relays required for bucholtz trip, tap changer bucholtz trip, HV winding temperature trip, LV winding temperature trip, oil temperature trip and low oil level trip, PRV trip shall be provided. Each auxiliary relay shall have 2 pairs of contacts and one hand reset flag indicators. The auxiliary relays may be of non-draw out type.

e) Numerical Local Breaker Backup Protection scheme for 132 kV Transformer breakers:

i) This scheme shall Comprise of a breaker failure initiating relay associated with transformer protection schemes, breaker failure relay which supervises the fault current flowing through the breaker being protected against failure and breaker failure time delay relay and breaker failure lockout relay.

ii) The operation of both breaker failure initiating relay and breaker failure relay will initiate timer relay which in turn operates lockout relay.

iii) Breaker failure relay scheme above shall:

i) be triple pole type

ii) be suitable for 220 V DC supply

iii) have an operating time of less than 15 milli seconds

iv) have a resetting time of less than 15 milli seconds

v) have two over current and one earth fault elements

vi) be of numeric type

vii) have a setting range of 20-320% of rated current for phase over current and 20-80% for ground over current

viii) have continuous thermal withstand rating of two times rated current irrespective of the setting

ix) have a separate/in built timer with a continuously adjustable setting range of 0.1 to 1 sec. On pick up.

x) have necessary auxiliary relays to make a comprehensive scheme

f) Numerical under voltage relay scheme for Power Transformers:

It shall be offered as a separate relay or built in feature.

i) Transformers are provided with tap changers having tap variation upto +5 to -15% on HV side. This 15% variation is necessary for meeting system demand. In case of sudden throw off of load or due to inadvertent operation of OLTC other equipment in the substations may be subjected to 15% over voltage. Hence necessary interlock and protection features are required for avoiding such a situation.

ii) The transformer OLTC gear shall be prevented from raising further beyond 15% tap if the LV bus voltage is normal i.e. at 11 kV. Necessary interlocking circuits, to prevent operation of tap changer will be provided on tap changer panel by using a N/C contact from 15% tap point.

iii) The under voltage relay shall have high drop off/pickup ratio. The relay shall be suitable for 110 V bus PT and shall have a setting of 60 % to 90% of nominal voltage in steps of 5 %. The relay shall be provided with 4 pairs of self reset contacts (N/C contact).

4.0 INSPECTION:

4.1 i) All routine tests shall be conducted at the time of inspection and inspection shall be made at the place of manufacturers unless otherwise specifically agreed upon by the manufacturer and purchaser at the time of purchase. The manufacturer shall offer the inspector representing the purchaser all reasonable facilities without charges to satisfy him that the panels/materials are manufacturers/supplied as per the specification/final approved drawings.

ii) The supplier shall give 15 days advance intimation to enable BHEL to depute his representative for witnessing acceptance and routine tests.

iii) The panels shall be manufactured and offered for inspection as per the final approved General Arrangement Drawing and schematic drawing which will be binding both on supplier and purchaser.

iv) The panels shall not be despatched from its point of manufacture unless the same are satisfactorily inspected and tested.

iv) The acceptance of any material shall in no way release the supplier of his responsibility for meeting all the requirements of the specification and shall not prevent subsequent rejection of such material later found to be defective.

5.0 QUALITY ASSURANCE PLAN:

5.1 The Contractor shall within 30 days of placement of order, submit the following information to the purchaser.

i) List of the raw material as well as bought out accessories and the names of sub-suppliers selected from those furnished along with the offer.

ii) Type test certificates of the raw material and bought out accessories if required by the purchaser.

iii) Quality Assurance Plan (QAP) with hold points for purchasers inspection. QAP and purchasers hold points shall be discussed between the purchaser and contractor before the QAP is finalised.

5.2. The Quality Assurance Programme shall give a description of the Quality Plans with the following details.

i) Quality Plans:

- An outline of the proposed work and program sequence.
- The structure of contractors organizations for the contract.
- The duties and responsibilities ensuring quality of work
- Hold and notification points.
- Submission of engineering documents required by this specification.
- The Inspection of the materials and components on request.
- Reference to contractors work procedures appropriate to each activity.
- Inspection during fabrication/construction.
- Final inspection and test.

6.0 GUARANTEED TECHNICAL PARTICULARS:

The guaranteed technical particulars of the equipment offered shall be furnished by the bidder.

7.0 DOCUMENTATION:

8.1 The bidder shall furnish the dimensioned drawings along with the bid indicating the details like components, make, quantity, ranges of meters, relays etc., in case the bidder quotes different makes of relays shall furnish copies of wiring scheme and literature, O&M Manuals in 4 sets of all relays.

8.0 PACKING AND FORWARDING:

8.1 Name plate (giving details of equipment) in all equipments (i.e. relays, breaker switches semaphore indicating lamps, push buttons etc.) mounted on the panel shall be provided. Name plates of suitable size on metal/PVC acrylic/thick plastic sheets shall only be provided. Stickers in no case will be accepted. Large and bold name plates shall be provided for circuit/feeder designation. Name plates for AC fuses, DC fuses, resistors and other equipment mounted inside the panel shall be provided clearly indicating the purpose for which they are meant for.

8.2 Suitable cushioning, protective padding or spacer shall be provided to prevent damage to or deformation of the components during transit and handling.

9.0 COORDINATION:

9.1 The bidder shall prepare and supply the coordination wiring diagrams between the control and relay panels and control switch gear as part of this contract.

9.2 The bidder shall coordinate in all respects with the manufacturers of associated equipment and shall freely exchange all relevant information to ensure satisfactory and economic over all design. No extra charge shall be payable for these services.

9.3 Erection of equipment called for in this specification will be undertaken by the BHEL. The bidder shall furnish full detailed instructions, complete with drawings and leaflets to enable satisfactory erection and commissioning. Such instructions should reach the BHEL sufficiently in advance of the receipt of the equipment in order that all the preliminary arrangement for the erection of the equipment can be made by the department in advance so that there will be no delay in regard to erection as soon as the equipment are received.

9.4 It is obligatory on the part of the bidder to make available services of their testing and commissioning engineers (with necessary testing equipment) to assist the staff in commissioning their equipment as and when their services are requisitioned.

10. PQ & Other Terms and Conditions

S.No	Other Terms and Conditions	Vendor Remarks
1.	<u>Prequalification Criteria</u> Vendor shall have successfully supplied 132KV or above transformer control & relay panel of atleast 1 number to AP/TS TRANSCO(or) to Industries with AP/TS TRANSCO metering facility. Vendor shall submit proof for the same. Along with the above commissioning/Performance certificate of the equipment from AP/TSTRANSCO/Industries needs to be Submitted.	
2	Vendor shall offer inspection of the above material to TSTRANSCO officials and BHEL officials. Only after clearance from TSTRANSCO official's material will be accepted.	
3	4 sets of test reports of each item to be submitted.	