GUJARAT ENERGY TRANSMISSION CORPORATION LTD.

SARDAR PATEL VIDYUT BHAVAN,
RACE COURSE, VADODARA - 390 007

TECHNICAL SPECIFICATIONS

FOR

400, 220, 132 kV CONTROL & RELAY PANELS

GETCO / E / TS – CRP 3601 / R8 September , 2022

SECTION - I

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SECTION - II

SPECIFICATIONS FOR 400, 220, 132kV SYSTEM CONTROL AND RELAY PANELS

In case, bidder is Control & Relay Panel manufacturer and not relay OEM, they have to submit Authorization and Service Back-Up Guarantee from the relay manufacturer for the offered relays.

1.0 SCOPE

1.1 The overall scope of work proposed to be assigned to the successful bidder according to this specification covers the following aspects.

1.1.1 **The design, preparation of schematic and drawings, manufacture & testing at manufacturer's works, mounting & wiring up of all the equipment and supply of the Protection Relays as detailed in the Schedule 'A' & 'G'.**

1.1.2 Design and manufacture of relay and relay assemblies to meet the requirements of various protection schemes for protection of

a) 400/220/132kV feeders
b) 400/220, 220/11kV, 220/66kV, **220/33kV**, 220/132kV, **132/66kV**, **132/33kV** Auto/Two winding transformers
c) 400/220/132kV Bus coupler
d) 400/220/132kV Transfer bus coupler
e) 400/220kV Reactor

1.1.2.1 Design and fabrication of relay panels for mounting the relay and relay assemblies along with all necessary accessories like switches, indicating lamps etc. and wiring up of the same to provide self contained and ready to use protection as per this specification.

1.1.3 Complete testing at manufacturer's works of the relays and protection schemes after mounting and fully wiring up in the relay panels.

1.1.4 F.O.R. destination supply of completely assembled control and relay panels.

1.1.5 **Supervision of testing and commissioning of these panels at site.**

1.1.6 It is not the intent to specify completely all the details of the design and construction of equipment. However, the equipment shall conform in all respects to high standards of engineering, design and workmanship as mentioned in clause 4.0 and shall be capable of performing continuous commercial operation up to the supplier's guarantee. In a manner acceptable to the purchaser, who will interpret the meaning of drawings and specifications, and shall have the power to reject any work of material which, in his judgment is not in accordance therewith. The offered equipment shall be complete with all components necessary for their effective trouble free operation. Such components shall be deemed to whether those are specifically brought out in this specification and/or the commercial order or not.

2.0 SCHEDULE OF REQUIREMENT

2.1 The requirement of control and relay panels to be supplied against this specification and their required deliveries are given in Commercial Terms and Conditions.

2.2 The delivery instructions shall be issued to the successful bidder/s after placement of orders and after inspection and testing of panels at manufacturer's works.

2.3 Recommended spares

The bidder shall furnish in his offer, a list of recommended spare with unit rates for control and relay panel that may be required for trouble free operation for a period of 25 years. The purchaser reserves the right of selection of items and quantities of these spares to be ordered. The bidder is bound to supply spares for maintenance as and when required for service life of the protections as per clause No.17.0.

2.4 Recommended tools, testing kits, test handles etc.

The bidder shall furnish in his offer a list of recommended testing kit, tools and test handle with unit rates for control & relay panels those may be required during testing and commissioning of said panel, off line as well as on line testing. The purchaser reserves the right of selection of items and quantities to be ordered.

2.5. **- Deleted -**

3. STANDARDS:

3.1. Unless otherwise specified elsewhere, in this specification, the rating, performance and testing of control and relay panels and accessories shall conform to the latest revisions, available at the time of placement of order of all relevant standards listed in Annexure – II.

3.2. The equipment shall also comply the latest revision of Indian Electricity Act and Indian Electricity Rules and any other applicable statutory provisions, rules and regulations applicable in the locations where these are to be installed.

4. PRINCIPAL TECHNICAL PARAMETERS:

The control & relay panel covered in these specifications shall have the technical requirements listed in Annexure – III.

5. GENERAL TECHNICAL REQUIREMENTS:

5.1. SCOPE OF WORK.

5.1.1. Design and fabrication of complete panels with provision for mounting all the associated equipment. The list of major mountings shall be given in Schedule – G.

5.1.2. Supply and mounting of all equipment as specified in Schedule `G' and in this specification together with such auxiliary equipment and materials as required. The bidder shall indicate make, type and designation of all equipments in the bid.

5.1.3. Complete internal wiring of equipment and terminal blocks and wiring between adjacent panels. Design and manufacture of relays and relay assemblies to meet the requirement of various protection schemes, specified hereunder for the panels as per Annexure – I.

5.1.4. Electrical detailing as outlined in this specification.

5.1.5. Preparation and furnishing of all the required drawings including schematic, internal external cable connection drawings and wiring schedules. All wires shall be ferruled at both ends even on shorting links also and shall be clearly shown in the schematic drawings.

5.1.6. Testing of panels and associated equipments and furnishing of test certificates.

5.1.7. Preparation and furnishing of erection, commissioning instructions, operation and maintenance manuals for all protections with all operational features/optional features.

5.1.8. **Supervision of testing and commissioning of all the supplied equipment at site.**

5.1.9. The successful tenders have to submit seven sets of all types of drawings, schematics and electrical internal circuits, indicating measuring points and measuring values, external cable connection drawings, wiring schedules, erection instructions, operation and maintenance manuals.

5.1.10. **DETAILS OF INSTRUMENT TRANSFORMRS AND POWER TRANSFORMRS (ICT)**

5.1.10.1. **400kV CURRENT TRANSFORMERS HAVING 1 AMP SECONDARY.**

Sr No.	Parameter	**Core - I**	**Core - II**	**Core - III**	**Core - IV**	**Core - V**
1	Ratio 2000-1000-500/	1 A	1 A	1 A	1 A	1 A
2	Rated Burden	---	---	40	---	---
3	Class of Accuracy	PS	PS	0.5	PS	PS
4	Accuracy Limit Factor	---	---	ISF < 5	---	---
5	Min KPV (Vk)	4000 at 2000/1	4000 at 2000/1	---	2000 at 2000/1	2000 at 2000/1
6	Max I_{ex} at Vk	30 on 2000/1,60 on 1000/1, 120 on 500/1	30 on 2000/1,60 on 1000/1, 120 on 500/1	---	30 on 2000/1,60 on 1000/1, 120 on 500/1	30 on 2000/1,60 on 1000/1, 120 on 500/1
7	Rsec (Ω)	10/5/2.5	10/5/2.5	10/5/2.5	10/5/2.5	10/5/2.5
8	Purpose	Trf / Line Main - 1	Trf / Line Main - 2	Metering	Bus Bar Protection	Bus Bar Protection

220/132kV CURRENT TRANSFORMERS HAVING 1 AMP SECONDARY

Sr No.	Parameter	**Core - I**	**Core - II**	**Core - III**	**Core - IV**	**Core - V**
1	Ratio 1200-600-300/	1 A	1 A	1 A	1 A	1 A
2	Rated Burden	30	30	---	---	---
3	Class of Accuracy	0.5	5P20	PS	PS	PS
4	Accuracy Limit Factor	ISF < 5	---	---	---	---
5	Min KPV (Vk)	---	---	1400 at 1200/1	1400 at 1200/1	1400 at 1200/1
6	Max I_{ex} at Vk	---	---	25	25	25
7	Rsec (Ω)	---	---	< 12	< 12	< 12
8	Purpose	Instru-mentation	Back-up Protection	Main – I Protection	Main – II Protection	Bus Bar Protection

Nos. of CT cores are typical. However, for 400kV and 220kV class it may be 4 nos. / 5 nos. for new /existing substation as per requirement.

For 132kV system, it may be 3 nos. / 4 nos. / 5 nos. as per requirement.

5.1.10.2. **400 kV CVT HAVING 110V AC SECONDARY CONNECTED TO 400 kV BUSBAR.**

Sr. No.	Parameter	**Core - I**	**Core - II**	**Core - III**
1	Ratio	400/√3 kV / 110/√3 V	4000/√3 kV / 110/√3 V	4000/√3 kV / 110/√3 V
2	Thermal Burden	100 VA	200 VA	200 VA
3	Class of Accuracy	0.2	3P	3P
4	Purpose	Instrumentation	Protection	Protection

220/132kV PT HAVING 110V AC SECONDARY CONNECTED ON 220/132kV BUS BAR

Sr. No.	Parameter	**Core - I**	**Core - II**	**Core - III**
1	Ratio	(220or132)/√3 kV / 110/√3 V	(220or132)/√3 kV / 110/√3 V	(220or132)/√3 kV / 110/√3 V
2	Thermal Burden	250 VA	250 VA (500VA if only two core)	250 VA
3	Class of Accuracy	0.5	3P	3P
4	Purpose	Instrumentation	Protection	Protection

5.1.10.3. **PARITCULARS OF POWER TRANSFORMERS**

A bidder shall collect the details of power transformers viz. Rating, Winding type, Vector Group etc for respective s/s from CE (Project), Corporate Office, GETCO, for detailed engineering of protection system.

5.2. **SIZE AND GENERAL DIMENSIONS REQUIREMENTS**

5.2.1. **220/132KV Control panel**: The control panels shall be `Simplex' type. The overall panel dimensions shall be 2312mm H (Height-H) x 750mm D (Depth-D) x 900mm W (Width - W).

5.2.2. **220/132KV Relay panel**: The relay panels shall be `Simplex' type. The overall panel dimensions shall be 2312mm H (Height - H) x 750mm D (Depth-D) x 900mm W (Width – W).

5.2.3. The relay panels shall be modular rack mounting type consisting of standard width racks, in accordance with the IEC – 297. The relays shall be as described under clause nos. 5.20 and 5.21. The relays shall be suitable to form composite relay assemblies in racks to form complete protection schemes with minimum external wiring involved. Ancillary components like switches, lamps etc whenever needed, for protection schemes shall be installed on plates suitable for mounting in racks. The relay panel have full transparent (Perspex) front door with lockable handle.

5.2.4. **GENERAL REQUIREMNT FOR CONTROL RELAY PANEL**

5.2.4.1. The slots for inter panel wiring shall be spaced at 300mm from top of the side panel and their size shall be 80mm (H) x 300mm (W).

5.2.4.2. Panels shall be completely metal enclosed and shall be dust, moisture and vermin proof to meet the requirement to IP-54 of IS: 2147.

5.2.4.3. The panels shall be free standing, floor mounting type and shall comprise rigid, welded structural frame enclosed completely with specially selected, smooth finished cold rolled sheet steel of thickness not less than 3mm for load bearing members (front panel, base frame, door frame) and 2.0mm for non load bearing members (side panel, cubicle roof, door). There shall be sufficient reinforcement to provide level surfaces, resistance to vibration, and rigidity during transportation and installation. No deviation to this clause is permitted.

5.2.4.4. All doors and removable covers shall be gasketed all round with neoprene gaskets, ventilating louvers, with screens and filters.

5.2.4.5. Design, material selection and workmanship shall be such as to result in neat appearance inside and outside with no weld, rivets or bolt heads apparent from outside and with all exterior surface true and smooth.

5.2.4.6. Purchaser's external cable connection will be terminated on the terminal blocks to be provided by the bidder in control and relay panels. Cable entries to the panels shall be from the two numbers of screwed type removable gland plates in panel bottom. Each of size 350mm x 200mm with punched hole for suitable size cable glands.

5.2.4.7. Simplex relay panel shall consist of vertical front panel with equipment mounted thereon and having wiring access from the rear. It shall have two doors.

5.3. **LABEL**

5.3.1. All front mounted equipment as well as equipment mounted inside the panels shall be provided with individual labels with equipment designation engraved. The labels shall be mounted directly below the respective equipment. Label with large and bold letters engraved with panel designation shall be provided at the top of each panel on front and rear side.

5.3.2. All the front mounted equipment shall also be provided tag numbers corresponding to the ones shown in the panel internal wiring to facilitate each tracing of wiring. These labels shall be mounted directly by the side of the respective equipment and shall not be hidden by the equipment wiring.

5.3.3. Labels shall be made of Aluminum anodized plate P.V. Castings. Labels shall have white letters on block background. All relays shall be given

standard abbreviation numbers with name of device, corresponding to the ones shown in the panel internal wiring.

5.3.4. Each instrument and meter shall be prominently marked with the quantity measured e.g. KV, A, MW etc.

5.3.5. Each switch shall bear clear inspection identifying its function e.g. `BREAKER', 52A, `SYNCHRONISING' etc. Similar inscription shall also be provided on each device whose function is 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 indication e.g. `Trip – Neutral – Close', `ON-OFF', `R-Y-B-OFF' etc.

5.4. MIMIC DIAGRAMS

5.4.1. The mimic diagrams shall be overlaid strip type. Mimic shall be of 10mm (W) X3mm (thick).

5.4.2. The colors for various voltages in the mimic diagram shall be as follows:

System voltage	Mimic colors	Shade No. as per IS - 5
a) 400KV	Dark violet	796
b) 220kV	Dark Brown	421
c) 132kV	Salmon Pink	443
d) 66 KV	Golden Brown	414
e) Earth	Green	221

5.4.3. When semaphore indicators are used for equipment position, they shall be mounted in the mimic, so that the equipment closed position shall complete the continuity of the mimic.

5.4.4. Indicating lamps, one for each phase, for each bus shall be provided on the mimic to indicate bus charged position which shall be of LED type having integral module type construction and suitable for 22.5mm cut out diameter.

5.5. POSITION INDICATORS

5.5.1. Semaphore indicators shall be provided for circuit breaker, isolators and earth switch. The semaphore indicator shall be suitable for flush mounting with terminal connections from the rear.

5.5.2. Position indicators shall be suitable for operation on 110 / 220Volts. D.C when the circuit breaker/isolator is in the close position, the point of the indicator shall take up a position in line with the mimic bus bars and at right angles to when the circuit breaker/isolator is in open position. When the supply failure occurs to the indicators, the point shall take up an intermediate position to indicate the supply failure. It shall not be possible to displace the position for indicator disc due to accidental touch during cleaning of the panel. The VA rating of the indicator shall be as low as possible.

5.6. CONTROL SWITCHES

5.6.1. Control and Instrument switch shall be rotary type provided with escutcheon plates clearly marked to show operating position and suitable for flush mounting with only the switch front plate and operating handle projecting out. The connections shall be from the rear. The contact assembly at the back of the switch shall be enclosed in dust tight removable covers. The access to the contacts shall be from the back by the removal of the cover. Contact assembly shall be smooth enough for operations.

5.6.2. Isolator/breaker control switch of "3 position spring return to neutral" type shall be provided. 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 position to `After Close' and `After Trip' positions respectively. The handle for breaker control switch shall have RED COLOUR.

5.6.3. Contacts of the switch shall be spring assisted and contact faces shall be silver plated. Spring shall not be used as current carrying parts. The contacts of all switches shall preferably open and close with snap action to minimize arcing. The contact rating of the switches shall be as follows:

	Description	**Contact rating in Amps.**		
		240V	**110VAC**	**220VDC**
a)	Make and carry continuously	10A	10A	10A
b)	Make and carry for 0.5 sec.	30A	30A	30A
c)	1) Resistive load 2) Inductive load with L/R = 40msec.	7A 7A	7A 5A	3A 2A

5.6.4. Trip transfer switch shall have 3 positions Normal/Intermediate/Transfer. All transfer switches shall have a common key which can be removed in normal position only to prevent operation more than one switch being in transfer position simultaneously. It shall be ensured that during transfer when two breakers in parallel are controlling the circuit, faults in circuits are successfully cleared. On transfer position, trip circuits of main C.B. shall be isolated and tripping of TBC only shall be extended on operation of protection or on manual operation.

5.6.5. 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. Make, type of the switch shall be suggested by Bidder.

5.6.6. Synchronizing switch shall be of maintained contact (stay put) type having a common key for group of switches. The key shall be removable only in the OFF position. These switches shall be arranged to connect the synchronizing 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. The synchronizing socket shall be BCH make 12 pin type.

5.7. **Instrument Switches**

Instrument selector switch shall be of the maintained contact (stay-put) type Ammeter selector switches shall have make before break type contacts so as to prevent open circuiting of C.T secondary when changing the position of the switch. If three ammeters are provided, this is to be omitted. Voltmeter selector switch shall be of 8 positions, 3 for phase to phase and 3 for phase to neutral readings and OFF position.

5.8. **Indicating instruments**

5.8.1. All electrical indicating instruments shall be taut band type 96mm x 96mm size and suitable for flush mounting with only flanges projecting on vertical panel with back connected terminals. All indicating instruments shall be of 240 degree scale.

5.8.2. Instrument dials shall be parallax free, while with black figures/lettering and knife edge pointer, with double scale as per ratio of CT, PT.

5.8.3. Instrument shall conform to relevant standards and shall have class of accuracy of 0.5 or better.

5.8.4. Wattmeter and VAR meters shall be suitable for measurement of 3 phases. 4 wire unbalanced loads.

5.8.5. Ammeter, Voltmeter, Wattmeter and VARmeter shall have linked 240 scales. Wattmeter and VARmeter will be center-zero type to indicate EXPORT/ IMPORT. Accuracy of indicating meter shall be 0.5 or better.

5.8.6. The MW / MVAR and Ampere meter of feeders and transformer control panel should be operated from separately mounted transducers so that local metering as well as remote telemetering at load despatch can be fed from the same source to avoid conflict of error between local station and load despatch readings.

5.9. **Energy Meter**

It shall be as per specifications mentioned in this tender.

5.10. **Transducers:**

Transducers are required to use with Recording/ indicating instruments and telemetry/ Data communication application. The transducers shall in general conform to IEC: 688-1 and have the following features.

a) The transducers shall be suitable for measurement of active power, reactive power, voltage, current and frequency in three phase four wire unbalanced system.

b) The input to the transducers will be from sub-station CT and PT. The output shall be in mA DC proportional to the input and it shall be possible to feed the output current directly to the telemetry terminal or indicating instruments or recording instrument.

c) The transducers characteristics shall be linear throughout the measuring range.

d) The input and output of the transducers shall be galvanically isolated.

e) The transducer shall derive its auxiliary supply from the external DC auxiliary supply or from the quantity to be measured.

f) Each transducer shall be housed in a separate compact case and have suitable terminals for inputs and outputs. Input side terminal connectors (from CT and PT) to be suitable for 3 phase, 4 wire connection.

g) The transducers shall be suitably protected against transient high peaks of voltage and current.

h) The transducers shall withstand indefinitely without damage and work satisfactorily at 120% of the rated voltage and 200% of the rated input current as applicable.

i) The transducers shall have two separate outputs each of 4 – 20 mA.

j) The response time of the transducers shall be less than 500 ms.

k) The transducers shall have a working temperature range of 0-50° c.

l) The accuracy class of transducers shall be 0.2 or better except for frequency transducers which shall be 0.2.

m) The transducers shall have low A.C ripple on output of less than 1%.

n) The transducers shall be suitable for load resistance of 4000 ohm.

o) The PT ratio and scale ranges for the voltage and frequency transducers shall be as follows:

	PT RATIO	**SCALE RANGE**
Voltage transducer	400kV/110V	0- 500 kV
	220kV/110V	0-300 kV
	132kV/110V	0-150 kV
	66kV/110V	0-75kV
Frequency Transducer	110V	45-55 Hz

The current, active and reactive power transducers shall be suitable for the various CT and PT ratios (as applicable) furnished with the specification and compatible with the feeder/transformer voltage level and rating.

p) The transducer shall be provided with terminal connector for wire of maximum cross section of 4mm sq., with dual screws, for rigid connections.

5.11. Panel Internal Wiring

5.11.1. All wiring shall be carried out with 1100V grade single core multi strand flexible copper conductor wires with HRPVC insulation and shall be flame retardant, vermin and rodent proof. The current carrying capacity of wire shall be adequate for the duty assigned to it considering short circuit condition and shall have sufficient flexibility to facilitate proper termination at any location. Colour coded wires (red, yellow, blue, black) shall be used for CT, VT and CVT secondary connections. The copper conductor used for internal wiring be as follows:

a) All circuits except instrument transformer circuit of 1.5 Sq mm per lead

b) CT circuit - one 2.5 Sq mm per lead.

c) VT circuits one 1.5 Sq mm per lead.

d) Energy metering - 2.5 Sq mm per lead for both PT & CT circuits.

5.11.2. Auxiliary bus wiring for AC and DC supplies voltage transformer circuits, annunciation circuits and other common circuits shall be provided near the top of the panels running throughout the entire length of the panels.

5.11.3. The wire numbers shown in the wiring diagram shall be in accordance with IS375/BS152/BS156. All wires directly connected to trip circuit breaker or devices shall be distinguished by addition of a red colored or lettered ferrule. Number 6 and 9 shall not be used.

5.11.4. Panel wiring shall be securely supported, neatly installed by lacing and tieing, readily accessible and connected to equipment terminals and terminal blocks. Flame retardant, plastic wiring channels/troughs with strap on plastic covers shall be used for this purpose. Sufficient space in channel for modification of wiring shall be kept.

5.11.5. Accidental short circuiting of certain wires is likely to result in malfunction of equipment, such as closing or tripping of a breaker or positive and negative wires, these wires shall not be terminated on adjacent terminal blocks.

5.11.6. The unused space on the front or rear of the panels shall be kept clear of wiring to facilitate addition of devices without rewiring associated portion of the panels.

5.11.7. Wire termination shall be made with solder less crimping type of tinned copper lugs, which firmly grip the conductor. Insulation 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.

5.11.8. The bidder shall be responsible for the completeness and correctness of the internal wiring and for the proper functioning of the connected equipment.

5.11.9. Terminations on T.B. shall be grouped function wise on one region of T.B. (may not be full T.B) to take outlet connections in one cable for the function.

5.12. **Interior Lighting**

5.12.1. The panel: shall be provided with fluorescent CFL tube with lighting fixture rated for 240V AC supply, controlled by panel door switch and fuse. The number of such fluorescent lighting fixtures shall be 1 no. per panel.

5.12.2. The panel shall be provided with 240V, 50Hz. 15 A, 3 pin universal socket with switch. The socket with switch shall be mounted inside the panel at convenient location.

5.13. **Earthing**

5.13.1. Each panel shall be provided with earth bus tinned copper, having minimum cross section area of 25 x 6 sq mm flat securely fixed along with inside base of panels. Since several control panels are to be 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. Provision shall be made to extend the earth bus bars to future adjoining panels. Provision shall be on the earth bus of the end panels for connecting owner's earthing grid. Necessary terminal clamps and connectors for this purpose shall be included in the scope of supply, of the contractor.

5.13.2. All metallic cases of relays, instruments and other mounted equipment shall be connected to earth bus by copper wires of size not less than 2.5 sq. mm. The colour of the earthing wire shall be green.

5.13.3. 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.

5.13.4. VT, CVT and CT secondary neutral or common lead shall be earthed at one place only. Such earthing shall be made through links, so that earthing may be removed from one group without disturbing continuity of earthing systems for other group.

5.13.5. A separate earthing point shall be provided in the panel for cable screens of static equipment, insulation between two earths prior to connections of the two earths to the Purchaser's earthing grid, shall withstand a test voltage of 500V for 1 minute (or higher insulation resistance of not less than 1 meg-ohms at 500V) connection between the screen terminals and the screen earth – point shall be jumper wires. Connection of this earth point to the station earth shall be carried out by Purchaser.

5.14. **Indicating lamps**

5.14.1. Indicating lamps - LED shall be panel mounting type with rear terminal connections. Lamps - LED shall have translucent lamp covers to diffuse lights, colored red, green, amber, clear white or blue as specified. The lamp - LED cover shall be preferably screwed type, and molded from the fire resisting material.

5.14.2. Lamp/ Lenses shall be interchangeable and easily replaceable from the front of the panel. Tools if any required for replacing the bulbs and lenses shall also be included in the scope of supply.

5.14.3. Multi LED with uniform bright illumination shall be provided. The wattage of the LED lamps shall be less than 0.6 W.

5.14.4. Indicating lamp for circuit breaker close-trip, position shall be provided. The colour of the `close-and-trip' position shall be red and green respectively.

5.14.5. Indicating lamp for isolators' ON-OFF position shall be provided. The colour of the ON and OFF position shall be red and green respectively.

5.14.6. Provisions shall be made for additional 2 nos. of indicating lamp for any other indication of circuit breaker accessories like SF-6 Gas monitoring, air pressure etc. The colour of these lamps shall be white.

5.15. **Terminal blocks**

5.15.1. Terminal blocks shall be 1100 V grade, 45 amps rated, one piece moulded, complete with insulated barriers, stud type, melamine housing brass terminals, washers, brass nuts and brass lock nuts and identification strips. Markings on the terminals strips shall correspond to wire number on the wiring diagrams. Not more than 2 wires shall be connected to any terminals.

5.15.2. Terminal blocks for CT, CVT and VT secondary leads shall be provided with test links and isolating facilities. CT secondary wiring should be such that it can connect additional circuit in series.

5.15.3. At least 20% spare terminals shall be provided in each panel and these spare. Terminals shall be uniformly distributed on all terminal blocks, near each group of connections for function wise circuits.

5.15.4. All spare contacts and terminals of the panel mounted equipment and devices shall be wired up to terminal blocks with ferrule numbers starting with U.

5.15.5. Unless otherwise specified, terminal blocks shall be suitable for connecting the following conductors of purchaser's cables on each side.

5.15.5.1. All DC and auxiliary AC circuits -- minimum one of 2.5mm^2 copper
5.15.5.2. All CT & PT circuits -- minimum two of 2.5mm^2 copper

5.15.6. Cable gland plate fitted on the bottom of panel shall be connected to earthing of panel/station through a flexible brained copper conductor rigidly.

5.15.7. There shall be minimum clearance of 250mm between the first row of terminal blocks and the associated cable gland plate. Also the clearance between two rows of terminal blocks edge shall be minimum of 150mm.

5.15.8. Molding materials shall be self extinguishing or resistant to flame propagation, substantially non hydroscopic and shall not carbonized when tested for tracking. The insulation between any terminal and framework between adjacent terminals shall with stand test of 2kV rms. For one minute. The molding shall be mechanically robust to withstand handling while making terminations.

5.15.9. Easily removable Protective transparent plastic covers for placing over the live parts of the terminal blocks shall be provided invariably.

5.16. **Annunciation System**

5.16.1. Alarm annunciation system shall be provided on the control board by means of visual and audible alarm in order to draw the attention of the operator to the normal operating conditions or the operation of some protective devices and DC fail condition. The annunciation equipment shall be suitable for operation on both 220/110V DC (selectively) for normal operating conditions or the operation of some protective devices and 240 V AC for DC fail conditions.

5.16.2. Alarm annunciation shall be of microprocessor based with replaceable windows, NO/NC selectable, sequence/ grouping selectable, choice of colors, choice of windows sizes and availability of serial part (RS232 to RS 485) output for computer connection. It shall have repeat relay card AC/DC fail facility and LED facia. The windows based PC software, cables, converters etc. shall also be provided. 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	a)Close b)Open	Steady on Steady on	Off Off
4.a) Reset Push button pressed b) If abnormal condition persists	a) Close b) Open Close	Steady on Off Flashing	Off Off Off
5. Lamp Push button pressed	Open	Steady on	Off

5.16.3. The visual annunciation shall be provided by annunciation fascia, mounted flush on the top row of the panels. The audible alarm shall be provided on alarm hooter and bell to differentiate the TRIP AND NON TRIP alarm respectively.

5.16.4. Annunciator fascia unit shall have translucent plastic windows for each alarm point. Annunciation facia shall be engraved in black-in-white lettering for NON TRIP alarm and black-in-red lettering for TRIP alarm.

5.16.5. Alarm inscription shall be engraved on each window in not more than three lines and size of the lettering shall be about 5mm. The inscription shall be visible only when the respective fascia light is `ON'.

5.16.6. The cover plate of the fascia windows shall be flush with the panel and shall be easily removable. The fascia window shall have two white lamps in parallel to provide safety against lamp failure. The lamps provided in the fascia 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.

5.16.7. 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 annunciator from ` close to fault' to `Open to Fault' and vise versa.

5.16.8. Unless otherwise specified, one alarm hooter and bell common to annunciator on all the panels shall be provided.

5.16.9. Each annunciator shall be provided with accept, reset and test push buttons.

5.16.10. Special precaution shall be taken by the supplier to ensure that alarm conditions do not appear due to influence of external electromagnetic / electrostatic interference on the annunciator wiring and switching disturbances from the neighboring circuits within the panels.

5.16.11. In case `RESET' push button is pressed before abnormality is cleared, the lamps shall continue to flash and shall go out only when `normal' condition is restored.

5.16.12. Any new annunciation appearing after the operation of `accept' for previous annunciation, shall provide a fresh `audible alarm' with accompanied `visual alarm' even if the process of `acknowledging' or `resetting' of previous alarm is going on or is yet to be carried out.

5.16.13. Provision of testing facilities for flasher and audible alarm circuit of annunciator shall also be made.

5.16.14. The annunciation shall be of repetitive type and shall be capable of registering fleeting signal registered by the system shall be of 15ms.

5.16.15. The schematic drawing of annunciation shall be required to be submitted by the successful bidders. The one set of spare cards/relays shall be supplied along with the panels for an individual station.

5.16.16. The annunciation in facia shall be grouped for tri in one / more row and non trip be grouped in balance rows.

5.16.17. The spare facia window provided should have facility to engrave the inscription on site.

5.16.18. Auxiliary relay for annunciation system shall have adequate auxiliary potential free contacts for used in DR and SER.

5.16.19. The annunciator shall have minimum 36 windows for each scheme.

5.17. **Push buttons**

5.17.1. Push buttons shall be momentary contact type with rear terminal connections. The push button shall be suitably shrouded to prevent inadvertent operation. It shall be provided with integral inscription plate engraved with its function. The contacts of push button shall be able to make and carry 5A break 1A inductive load at 250V DC.

5.17.2. All push buttons shall have two normally open and two normally closed contact. The contact shall be silver plated. The contacts shall be able to make/break and carry appropriate current for the functions desired.

5.18. **Painting**

5.18.1. All sheet steel work shall be phosphated in accordance with the following procedures and in accordance with IS; 6005 `Code of Practice for phosphating iron and steel'.

5.18.2. Oil, grease, dirt and swart shall be thoroughly removed by emulsion cleaning.

5.18.3. Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying.

5.18.4. After phosphating, through rinsing shall be carried out with clean water followed by final rinsing with dilute bi-chromate solution and oven drying.

5.18.5. The phosphate coating shall be sealed by the application of two coats of ready mixed, stowing type zinc chromate primer. The first coat may be `Flash dried' while the second coat shall be stowed.

5.18.6. After application of the primer, two coats of finishing synthetic enamel paint shall be applied, each coat followed by stowing. The second finishing coat shall be applied after completion of tests. The panel shall have colour confirming to shade 631 of IS-5 for outside. Inside of the panel will be egg shell white.

5.18.7. Each coat of primer and finishing paint shall be of a slightly aesthetically pleasing appearance free from dirt and uneven surface.

5.18.8. Finished painted appearance of panel shall present an aesthetically pleasing appearance free from dirt and uneven surface.

5.18.9. The bottom plate shall be painted with anti corrosive paint.

5.18.10. A small quantity of finishing paint shall be supplied for minor touching up required at site after the installation of the panel.

5.18.11. The paint thickness shall be 60- 100 microns for powder coating.

5.19. **Mounting**

5.19.1. All equipment on front of panel shall be mounted flush.

5.19.2. Equipment shall be mounted such that removal and replacement can be accomplished individually without interruption of service to adjacent equipment. Equipment mounted inside the panel shall be so located that terminals of adjacent devices are readily accessible without the use of special tools. Terminal markings shall be clearly visible.

5.19.3. Cut-outs and wiring for free issue items. If any, shall be according to corresponding equipment manufacturer's drawings, cut-out, if any provided for future mounting of equipment shall be properly blanked off.

5.19.4. The center line of switches, push – buttons and indicating lamps shall be at a height not less than 750mm from the bottom of the panel. The center line of relays, meters and recorders shall be at a height not less than 450mm from the bottom of the panel.

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

5.19.6. No equipment shall be mounted on the doors without prior approval of the purchaser.

5.19.7. Panels shall be matched with other panels in the control room in respect of dimensions, colour, appearance and arrangement of equipment on the front.

5.19.8. At the existing stations, centre lines of switches, push buttons and other equipment shall be in line with existing panels.

5.20. RELAYS

5.20.1. The general requirements for the protective relays are described here under however, all relays shall in general comply with the technical specifications mentioned in Annexure-III.

5.20.2. All relays shall confirm to the requirements of IS: 3231/IEC-60255 or other applicable standards. Relays shall be suitable for flush or semi-flush mounting on the front with connections from the rear.

5.20.3. All protective relays shall be with proper on line testing facilities without isolation from TB where inputs viz CT/ PT / CVT and DC are wired. All main relays shall be provided with test plug to test the relay on line & required test handle may be invariably indicated in list as mention in Cl. 2.4 Necessary test plugs/ test handles shall be supplied loose and shall be included in bidder's scope of supply.

5.20.4. All AC operated relays shall be suitable for operation at 50 Hz. AC voltage operated relays shall be suitable for 110V VT / CVT secondary and current operated relays for 1or 5 amp. CT secondary. All DC operated 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.

5.20.5. **REQUIREMENT OF AUXILIARY RELAYS FOR AUXILIARY CONTACT MULTIPLICATION OF 400/220/132 kV ISOLATORS, EARTHSWITCH AND BREAKER**

5.20.5.1. Latched type auxiliary relay having sufficient Nos. of contacts for completing the scheme and spare for use in future shall be used for contact multiplication of each isolator and for each breaker with unlatched Flag / LED Indication.

5.20.5.2. These contacts will be used for status indications, switchgear interlocks, DR & SER etc.

5.20.5.3. These contacts multiplication relays shall be completely wired up to the terminal blocks of the control panel.

5.20.6. 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 etc. 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 relays coils and contacts, including spare contacts.

5.20.7. All protective relays, auxiliary relays and timers except the lockout relays and interlocking relays specified shall be provided with self-reset type contacts. All protective relay and timers shall be provided with externally hand reset positive action operation indicators with inscription. 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. Similarly, separate operating indicator (auxiliary relays) shall also be provided in the trip circuits of protections located outside the board such as buchholz relays, oil and winding temperature protection, sudden pressure devices, fire protection etc.

5.20.8. Timers shall be of the solid state & shall be of continuous rating. Time delay in terms of mili seconds obtained by the external capacitor resistor combination is not acceptable. The variable pot type timer is not acceptable.

5.20.9. **Relay shall not give trip command when it is de-energized.**

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

5.20.11. All protective relays and alarm relays shall be provided with one extra isolated pair of contacts wired to terminals exclusively for future use.

5.20.12. **- Deleted -**

5.20.13. **- Deleted -**

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

5.20.15. All relays and their drawings shall have phase indications as R-Red, Y-Yellow and B-Blue.

5.20.16. Wherever numerical relays are used, the scope shall include the following:

a) Necessary original customized licensed software and hardware to up/down load the data to/from the relay from/to the Computer in the substation. However, the supply of Computer is not in the scope of supply.

b) The software shall be suitable for operations like switching, retrieval of information or changing of setting groups, retrieve oscillographic fault data from the relay memory and to store fault record data as oscilloraphic records in standard COMTRADE format. The software shall be suitable to provide oscilloraphic data into several different graphical representations that can be used to analyze the fault or event captured by the relay. It shall also be possible to calculate additional values from the captured signals and displaying analog curve with time base phasor diagram locus diagrams, harmonic graphs etc. Automatic upload of DR files should be possible.

c) The relay shall have suitable communication facility on fiber optic port / RS 485 for future connectivity to SCADA. The relay shall be capable of supporting communication protocols, as specified in respective relay specification. Neither the interface hardware nor the software for connectivity to SCADA will form part of the scope of this specification.

d) The relay shall be supplied with all the original customized licensed software, IO Cards, required cable for local or remote communication mentioned in the catalogue including all optional items.

5.20.17. All unused terminal shall also be provided with screws washers, lugs etc as for used terminal.

5.20.18. **- Deleted -**

5.20.19. The type test offered for relay shall be supplied with full options of protection and control functions mentioned in the catalogue.

5.20.20. **REQUIREMENT OF DIRECT CARRIER INTERTRIP FOR 400/220/132KV LINES (TWO MAIN + TRANSFER BUS SCHEME):**

Instantaneous tripping of the remote end breaker shall be achieved through the direct carrier inter-trip tele-link in case any of the following operations/occurrences.

5.20.20.1. Hand tripping of the 400/220/132 kV line breakers.

5.20.20.2. Hand tripping of the 400/220/132 kV TBC (Transfer bus coupler) breaker if the line is controlled by the TBC breaker.

5.20.20.3. Operation of the local breaker back up protection.

5.20.20.4. Operation of the transfer bus bus-bar protection relay, if the line is on the transfer bus.

5.20.20.5. Over voltage protection operation.

5.20.20.6. Bus bar protection operation.

Sufficient number of contacts shall be provided on the concerned switches relays, etc. to enable transmission of the carrier impulse by two independent carrier channels simultaneously.

5.21. **Synchronizing Trolley**

5.21.1. A synchronizing trolley as specified in Annexure – IV shall be supplied with panels. It shall be fully enclosed, mounted and wired with equipment as listed in Annexure – IV.

5.21.2. The trolley shall be of mobile type with four castor wheels capable for rotating in 360 degrees round the vertical axis. Suitable bumper with rubber padding shall be provided all round the trolley to prevent any accidental damage to any panel while the trolley is in movement.

6. TESTS

6.1. Type test

6.1.1. **The following tests from NABL accredited laboratory shall be carried out in accordance with latest / amended / up to date IS/IEC. The bidder has to submit all the type test reports as stated hereunder for the offered item along with the technical bid. The type test reports from NABL approved laboratory shall not be older than seven years. Type test reports shall be valid as on the last date of submission of bid.**

(A) Type Test of Control & Relay Panels

i. Degree of Protection IP54

(B) Type Tests of Relays

a. Performance tests:

i. Accuracy requirements
ii. Limits of operating range of auxiliary energizing inputs and auxiliary voltage dependence
iii. Limits of frequency range and frequency
iv. dependence
v. Rated burden
vi. Mechanical Endurance test
vii. Characteristic and Functional test

b. Thermal requirements:

i. Maximum allowable temperature
ii. Limits of short time thermal withstand value of input energizing quantities.
iii. Limiting dynamic value

c. Insulation Tests:

i. Dielectric Tests
ii. Impulse Voltage withstand Test
iii. Insulation resistance measurement

d. Influencing Quantities

i. Permissible ripples
ii. Interruption of input voltage

e. Electromagnetic Compatibility Test:

i. 1 MHZ burst disturbance test

ii. **Electrostatic Discharge Test**
iii. **Radiated Electromagnetic Field Disturbance Test**
iv. **Electrical Fast Transient Disturbance Test**
v. **Conducted Disturbances Tests induced by Radio Frequency Field**
vi. **Magnetic Field Test**
vii. **Emission (Conducted and Radiated) Test.**
viii. **Surge Immunity Test**

f. **Contact performance Test**
   i. **Contact making/Breaking capacity test**
   ii. **Continuous capacity test**

g. **Environmental tests:**
   i. **Dry Cold Test**
   ii. **Dry Heat test**
   iii. **Storage temperature test**
   iv. **Damp heat Cyclic test**

h. **Mechanical Tests:**
   i. **Vibration response & Vibration endurance test**
   ii. **Bump test**
   iii. **Shock response test**
   iv. **Seismic test**

i. **Enclosure Test:**
   i. **Degree of Protection test – IP51**

j. **Safety Test:**
   i. **Single fault condition assessment**
   ii. **Earth bonding impedance test**
   iii. **Mechanical resistance to shock and impact**
   iv. **Protection against electrical shock**
   v. **Protection against the spread of fire**

6.1.2. **- Deleted -**

6.1.3. **- Deleted -**

6.1.4. **<u>Important Note :</u>**

In case of non-submission / partial submission or type test reports of which validity is over, the bidder shall submit pending type test report/s from NABL accredited laboratory, in the event of an order, before commencement of supply without affecting delivery schedule, free of cost to GETCO. Confirmation for above shall be invariably submitted along with technical bid.

6.2. **<u>Acceptance and routine tests</u>**

6.2.1. All acceptance and routine test as stipulated in the relevant standards shall be carried out by the supplier in presence of Purchaser's representative without any extra cost.

List of Acceptance and routine tests

1. **Identification and verification of Type/Designation, Detailed model no. and Rating**
2. **Physical inspection**
3. **High voltage test (2kV for 1 min.)**
4. **IR test**
5. **Permissible auxiliary voltage test**
6. **Secondary Injection**
7. **Functional tests**
8. **Trip time measurement**
9. **Binary Input, Output and LED operation checks**
10. **Communication with the Computer through software**

6.2.2. Immediately after finalization of the program of type / acceptance / routine / testing the supplier shall give two weeks advance intimation to the purchaser to enable him to depute his representative for witnessing the tests.

7. INSPECTION DURING MANUFACTURING

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

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

7.3. The purchaser reserves the right to insist for witnessing the acceptance routine testing of bought out items.

8. QUALITY ASSURANCE PLAN

8.1. The bidder shall invariably furnish along with his offer the quality assurance plan adopted by him / his sub-suppliers in the process of manufacturing all major equipment/component.

8.2. Precaution taken for ensuring usage of quality raw materials and sub-components shall be stated in the quality assurance plan.

8.3. The bidder should specifically express their consent to accept additions, revisions to their quality assurance plan to meet the purchaser's requirements if needed. The final quality assurance plan to be adopted, with mutual consent, shall be decided after discussion with successful bidder.

8.4. **- Deleted -**

9. PERFORMANCE GUARANTEE

All equipments supplied against this specification shall be guaranteed for a period of 24 months from the date of receipt at the destination store centre. However, any engineering error, omission, wrong provision, equipment failure etc., if found during actual commissioning of the equipment, it shall be **replaced by the bidder within 3 months at free of cost. Any transportation required shall be arranged by the bidder. The guarantee period in such case shall be considered from the date of the replacement i.e. receipt of the new equipment at the site.**

9 (A) - Deleted -

10. DOCUMENTATION

10.1. The **successful** bidder shall furnish as a part of their offer, complete set in duplicate of technical literature/catalog & manuals (one no. shall invariably the original one and not Photo copy), and one set of typical schematic drawings in respect of all the control and protection equipment/ schemes, offered by them.

10.2. After issue of detailed purchase order, the successful bidder shall submit within six weeks, four sets of complete drawings along with detailed bill of material for approval to the CE (Projects), GETCO, Sardar Patel Vidyut Bhavan, Race Course, VADODARA -390 007. In normal practice, the documents submitted for the approval will be commented upon or approved if in order, within 30 days from the date of receipt of the same in the GETCO, Sardar Patel Vidyut Bhavan, Race Course, VADODARA -390 007.

10.3. The manufacturing of the equipment shall be strictly in accordance with the approved drawings and no deviation will be permitted without the written approval of the GETCO. All manufacturing work which is not as per the approval shall be at the supplier's risk.

10.4. Before dispatch of equipment to various consignees, the supplier shall furnish sets of final drawings, including bill of materials and wiring schedules and also sets of technical literature and commissioning manuals in suitable files. These shall be 7 sets per sub-station and shall be furnished as below.

A) 2 sets per C&R panel shall be sent to concerned sub-station.
B) 2 sets per C&R panel shall be sent to consignee before the dispatch of equipment.
C) 2 sets per C&R panel shall be sent to Corp. Office, GETCO.
D) 1 set shall be provided inside the panel.

All drawings shall be of A-3 size (297mmX420 mm). Final Drawing, Technical literature and commissioning manuals shall be printed and not Photo copy.

10.5. Supplier shall also furnish one complete set of reproducible of the relevant drawings. These shall be furnished to CE (Project), GETCO, Sardar Patel, Vidyut Bhavan, Race Course, Head Office, Baroda-390 007 immediately after the final inspection of various equipments, before dispatch.

10.6. **No material / item shall be dispatched without dispatch instruction from purchaser.**

11. PACKING AND TRANSPORT

11.1. All equipment/material shall be suitably packed for transport, carriage at site and outdoor storage during transit. The **supplier** shall be responsible for any damage to the equipment during transit due to improper and inadequate packing. The cases containing easily damageable material shall be very carefully packed and marked with appropriate caution symbols i.e. `FRAGILE' `HANDLE WITH CARE', `USE NO HOOK' etc. The contents of each package shall bear marking that can be readily identified from the package list and packing shall provide complete protection from moisture, termites and mechanical shocks etc.

11.2. Wherever necessary proper arrangement for attaching slings for lifting shall be provided and all packages clearly marked with gross weight, signs showing `UP' and `DOWN' sides of boxes, contents of each package, order no. and date, name of the plant/SS/ of which the material in the package forms part of and any handling and unpacking instructions considered necessary. Any material found short inside the intact packing cases shall be supplied by the manufacturer/supplier without any extra cost.

11.3. Bidder shall ascertain, prior to shipment, from concerned authorities, the transport limitations like weight and maximum allowable package size for transportation. Fragile material such as relay cases, Instruments and other glass material shall be carefully covered with shock absorbing protective materials, such as thermocol, silica gel or equivalent moisture absorbent material in small cotton bags shall be placed inside the packing wherever necessary.

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

a) Purchase order reference.

b) Name of consignee

c) Details of consignment

d) Destination

e) Total weight of consignment

f) Handling and unpacking instructions.

g) Bill of materials indicating contents of each package

h) Sign showing upper/lower side of the crate.

12. TRAINING

12.1. **The successful bidder is required to impart training in view of manufacture, assembly, erection, operation and maintenance for offered item, at each of the Three Zones (Rajkot, Mehsana and Bharuch Zone) of GETCO, to the person/s identified by GETCO, for one day, at free of cost.**

During the training, relay configuration, wiring and testing shall also be demonstrated. Testing kit will be arranged by GETCO.

12.2. **- Deleted -**

12.3. The programme of the training shall be mutually discussed and finalized by the purchaser with suppliers.

13. SUPERVISION OF TESTING & COMMISSIONING

13.1. The **successful** bidder shall depute their Engineer to the various sites for carrying out supervision of testing and commissioning of C&R panel, **as per Clause 19, section-II of this specification**. The purchaser shall provide an adequate number of skilled/unskilled workers as well as all ordinary tools and equipment required for equipment commissioning at his (purchaser's) expenses.

13.2. **- Deleted -**

14. SCHEDULES

14.1. The bidder shall fill in the following schedules which form **a part of the tender** and offer. If the schedules are not submitted duly filled in with the offer, the offer is likely to be rejected.

Schedule – B	Guaranteed Technical particulars
Schedule – G	List of equipment for control and relay panels.

14.2. **The bidder shall bring out all the technical deviation/s at the specified Annexure – XII only.**

14.3. **- Deleted -**

15. INFORMATION TO BE FILLED IN INVARIABLY BY THE BIDDER:

For ready reference of the purchaser, the information of items required to be invariably furnished by him in his offer, are listed below:

1. Schedule - `B' and `G'.
2. Documents and drawing listed in Clause no.10.1 to 10.5.
3. Documents specified in clause no.8.0

16. - Deleted -

17. GUARANTEE FOR MAINTENANCE SPARES AND SERVICES

The bidder shall guarantee for supplying maintenance spares and services as well as repairing of relays for a period of the life expectancy of 25 years.

18. D C DISTRIBUTION AND DC SUPERVISION

18.1. 220/110 V DC distribution for the C&R panels shall be such that separate sub – circuits with suitable HRC Fuse is provided for each of the following:

a) Main I / Main II CKT

b) Isolators/Earth switch control / interlock

c) Indication / annunciation

d) Breaker and isolator auxiliary contact multiplication

e) Circuit breaker closing

f) Circuit breaker tripping

g) Bus-bar protection

h) LBB protection

i) Main – I carrier scheme/Main II carrier scheme.

j) Synchronizing circuit.

k) Remote end trip isolating link for channel I and II.

18.2. DC supervision shall be provided to supervise continuously the DC supply for the above circuits (i.e. for I, ii, iii, iv, v). The scheme shall be suitable to work on 220/110 VDC supply from the station battery, and shall have position for visual as well as audio alarm. One number indicating lamp along with `accept' push button shall be provided on each control panel for this purpose. One hooter, for each panel shall be supplied for DC fail alarm.

18.3. Auxiliary relays used for the DC supervision scheme shall have adequate number of elements (minimum 5 nos.) with suitable self reset type operation indicators wherever applicable.

18.4. There shall be two DC source. Distribution of circuit should be as per working M1 and M2 protection, independently. The scheme to be designed to operate two group of relays on separate battery and if required all relays i.e. two groups can be connected on either of DC source by using source -1, intermediate source – II i.e. three position switch to change position and negative terminals coming from two different sources.

19. GENERAL IMPORTANTS

1. The successful bidder shall supervise & ensure inter relay communication and time synchronization during testing & commissioning at site.
2. If asked GPS Unit suitable for IRIG-B and other Pulse output ports shall be supplied and commissioned. It shall be wired with IRIG-B port of Numerical Bus bar Protection relay so that time synchronization of all the relays is achieved through inter-relay looping as mentioned above.
3. The schematic diagram shall be prepared in such a way that Auto Re-closure feature of Main I and Main II Distance Protection Relay is extended to TBC also when it is used for transferring load of any feeder.
4. Any modifications in wiring required by the purchaser at site shall be carried out by the successful bidder at the time of commissioning, free of cost.
5. The successful bidder has to provide reproducible tracings/ soft copy for all the drawings as a part of supply contract to the CE (Projects) GETCO, HO, VADODARA for documentation.
6. **- Deleted -**
7. The successful Bidder has to provide instruction manual, all drawings, literature etc. for all relays and devices, write up for testing and commissioning procedures, relay setting calculations etc. detailed circuit diagrams with trouble shooting protocols to all consignee destinations as well as to the SE(Testing), GETCO, and the CE.(Projects) GETCO, HO, VADODARA
8. The successful bidder has to do **supervision of** testing & commissioning of C&R panel at site by deputing his Service Engineer free of cost. The 10% value of order is to be retained over and above the money retained as per payment terms of the GETCO and the same is to be released after satisfactory first testing and commissioning of the C&R panel.

Annexure-I

Protection Requirements for various C&R Panels

400kV System, 1½ Bkr Configuration								
Panel Type	**BCU**	**Main I Protn.**	**Main II Protn.**	**B/U Protn.**	**O/V Protn.**	**DC Sup**	**Synch Socket**	**Remark**
Feeder C&R panel 220 V DC	Bay Control Unit (Protocol – 61850)	Dist Protn, With DR (Protocol – 61850)	Dist Protn, With DR (Protocol – 61850)	X	√	√	√	
Tie Bkr C&R panel 220 V DC	Bay Control Unit (Protocol – 61850)	Teed Protn*, Low Imp Diff relay With DR (Protocol – 61850)	Teed Protn* High Imp Diff Relay With DR (Protocol – 61850)	X	X	√	X	
400/220 kV Trf. HV side, C&R panel 220 V DC	Bay Control Unit (Protocol – 61850)	Diff Protn, With DR (Protocol – 61850)	REF Protn, High Imp, With DR (Protocol – 61850)	Dir O/C & E/F, With DR (Protocol – 61850)	X	√	√	
400/220 kV Trf. LV side, C&R panel 220 V DC	X	X	X	Dir O/C & E/F, With DR (Protocol – 61850)	X	√	√	
Reactor C&R panel 220 V DC	X	Diff Protn, With DR (Protocol – 61850)	REF Protn High Imp, With DR (Protocol – 61850)	B/U Imp. With DR (Protocol – 61850)	X	√	X	
Bus Bar Protection 220 V DC	X	Distributed Bus Zone Protn for minimum 12 Bays With DR in Bay as well as Central Unit (Protocol – 61850)			X	√	X	

***** Teed Protn. shall be provided in Feeder, Transformer & Reactor C & R Panels.

400kV System, 3 Bus Configuration							
Panel Type	**Main I Protn.**	**Main II Protn.**	**B/U Protn.**	**O/V Protn.**	**DC Sup**	**Synch Socket**	**Annunciation Windows**
Feeder C&R panel 220 V DC	Dist Protn, With DR (Protocol – 61850)	Dist Protn, With DR (Protocol – 61850)	X	√	√	√	36
400/220 kV Trf. HV side, C&R panel 220 V DC	Diff Protn, With DR (Protocol – 61850)	REF Protn, High Imp, With DR (Protocol – 61850)	Dir O/C & E/F, With DR (Protocol – 61850)	X	√	√	36
400/220 kV Trf. LV side, C&R panel 220 V DC	X	X	Dir O/C & E/F, With DR (Protocol – 61850)	X	√	√	24
Reactor C&R panel 220 V DC	Diff Protn, With DR (Protocol – 61850)	REF Protn High Imp, With DR (Protocol – 61850)	B/U Imp. With DR (Protocol – 61850)	X	√	X	36
B/C C&R panel 220 V DC	X	X	Non-Dir O/C, With DR (Protocol – 61850)	X	√	√	36
TBC C&R panel 220 V DC	A/R With DR (Protocol – 61850)	X	X	X	√	√	24
Bus Bar Protection 220 V DC	Distributed Bus Zone Protn for minimum 12 Bays With DR in Bay as well as Central Unit (Protocol – 61850)			X	√	X	--

220kV System, 3 Bus Configuration							
Panel Type	**Main I Protn.**	**Main II Protn.**	**B/U Protn.**	**O/V Protn.**	**DC Sup**	**Synch Socket**	**Annunciation Windows**
Feeder C&R panel 220/110 V DC	Dist / # Line Diff. Protn, With DR (Protocol – 61850)	Dist / # Line Diff. Protn, With DR (Protocol – 61850)	X	X	√	√	36
220/132 kV Auto Trf. HV side C&R panel 220/110 V DC	Diff Protn, With DR (Protocol – 61850)	REF Protn High Imp, With DR (Protocol – 61850)	Dir O/C & E/F, With DR (Protocol – 61850)	X	√	√	36
220/132 kV Auto Trf. LV side C&R panel 220/110 V DC	X	X	Dir O/C & E/F, With DR (Protocol – 61850)	X	√	√	24
220/66 kV Trf. HV side C&R panel 220/110 V DC	Diff Protn, With DR (Protocol – 61850)	REF Protn High Imp, With DR (Protocol – 61850)	Dir O/C & E/F, With DR (Protocol – 61850)	X	√	√	36
220/66 kV Trf. LV side C&R panel 220/110 V DC	X	REF Protn High Imp, With DR (Protocol – 61850) (To be provided in HV Panel)	Dir O/C & E/F, With DR (Protocol – 61850)	X	√	X	24
B/C C&R panel 220/110 V DC	X	X	Non-Dir O/C, With DR (Protocol – 61850)	X	√	√	36
TBC C&R panel 220/110 V DC	A/R With DR (Protocol – 61850)	X	X	X	√	√	24
Bus Bar Protection 220 V DC	Distributed Bus Zone Protn for minimum 12 Bays With DR in Bay as well as Central Unit (Protocol – 61850)			X	√	X	--

220kV System, 2 Bus Configuration							
Panel Type	**Main I Protn.**	**Main II Protn.**	**B/U Protn.**	**O/V Protn.**	**DC Sup**	**Synch Socket**	**Annunciation Windows**
Feeder C&R panel 220/110 V DC	Dist / # Line Diff. Protn, With DR (Protocol – 61850)	Dist / # Line Diff., Protn With DR (Protocol – 61850)	X	X	√	√	36
220/132 kV Auto Trf. HV side C&R panel 220/110 V DC	Diff Protn, With DR (Protocol – 61850)	REF Protn High Imp, With DR (Protocol – 61850)	Dir O/C & E/F, With DR (Protocol – 61850)	X	√	√	36
220/132 kV Auto Trf. LV side C&R panel 220/110 V DC	X	X	Dir O/C & E/F, With DR (Protocol – 61850)	X	√	√	24
220/66 kV Trf. HV side C&R panel 220/110 V DC	Diff Protn, With DR (Protocol – 61850)	REF Protn High Imp, With DR (Protocol – 61850)	Dir O/C & E/F, With DR (Protocol – 61850)	X	√	√	36
220/66 kV Trf. LV side C&R panel 220/110 V DC	X	REF Protn High Imp, With DR (Protocol – 61850) (To be provided in HV Panel)	Dir O/C & E/F, With DR (Protocol – 61850)	X	√	X	24
B/C C&R panel 220/110 V. DC	X	X	Non-Dir O/C, With DR (Protocol – 61850)	X	√	√	36
Bus Bar Protection 220 V DC	Distributed Bus Zone Protn for minimum 12 Bays With DR in Bay as well as Central Unit (Protocol – 61850)			X	√	X	--

132kV System, 2 Bus Configuration							
Panel Type	**Main I Protn.**	**Main II Protn.**	**B/U Protn.**	**O/V Protn.**	**DC Sup**	**Synch Socket**	**Annunciation Windows**
Feeder C&R panel 220/110 V. DC	Dist / # Line Diff. Protn, With DR (Protocol – 61850)	X	Dir O/C & E/F, With DR (Protocol – 61850)	X	√	√	32
132/66 kV Trf. HV side C&R panel 220/110 V DC	Diff Protn, With DR (Protocol – 61850)	REF Protn High Imp, With DR (Protocol – 61850)	Dir O/C & E/F, With DR (Protocol – 61850)	X	√	√	32
132/66 kV Trf. LV side C&R panel 220/110 V DC	X	REF Protn High Imp, With DR (Protocol – 61850)	Dir O/C & E/F, With DR (Protocol – 61850)	X	√	X	24
B/C C&R panel 220/110 V DC	X	X	Non-Dir O/C, With DR (Protocol – 61850)	X	√	√	32
Bus Bar Protection 220 V DC	Distributed Bus Zone Protn for minimum 12 Bays With DR in Bay as well as Central Unit (Protocol – 61850)			X	√	X	--

These are the main protections. However, other ancillary relays required for the respective C&R panel viz. Trip Circuit supervision relay, Direct Trip Command relay, Transformer trouble relay, High speed trip relays, contact multiplication relay etc shall be as per tender technical specifications.

The following shall be included in case of new sub stations:

1. GPS time synchronizing unit.
2. Synchronizing Trolley
3. Automatic U/F Load Shedding Panel (Spec are to be enclosed separately)

Line Differential relays / relay shall be provided in 220kV / 132kV Feeder panels instead of Distance protection relay if specified in schedule-A or BOQ.

ANNEXURE: II
CONTROL AND RELAY PANELS – LIST OF STANDARDS

Sr.No.	Standard no.	Title
1.	IS-3231	Electrical relays for power system protection.
2.	IEC-255 Part 1 to 3	Electrical relays for power system protection.
3.	BS – 142	Electrical relays for power system protection
4.	IS – 1248 IS – 2419	Indicating instruments.
5.	BS – 89	Indicating instruments
6.	IS – 6236	Recorders
7.	BS-90	Recorders
8.	IS – 722	Energy meters & control switches (LV Switching devices for control and auxiliary circuits.)
9.	BS – 37	Energy meters, control switches (LV Switching devices for control and auxiliary circuits)
10.	IEC-337 & 337-1	Energy meters, control switches (LV Switching devices for control and auxiliary circuits)
11.	IS – 2705	Current transformers
12.	IS – 3156	Voltage transformers
13.	IS – 4237	General requirements for switches and control gear for voltages not exceeding 1 kV.
14.	IS – 375	Marking and arrangements for switch gear, bus bars, main connections and auxiliary wiring.
15.	BS – 152	Relay coding, auxiliary wiring and panel and wiring.
16.	IS – 8686	Static protective relays
17.	IS – 2147	Degree of protection for cubicles
18.	IEC-297 Part 1-3	Dimensions of mechanical structures of the 482.6mm (19)” series.
19.	IS – 6875	Control switches (LV Switching devices for control and auxiliary circuits)
20.	IS – 5	Colour for ready mixed paints and channels.
21.	IS – 1554 Part-I, 1988	PVC insulated cables up to and including 1000 volts.
22.	IS – 3842 Part- II to IV	Application guide for protection
23.	IS – 9224 Part- II	HRC Cartridge fuse links.
24.	IS – 6005	Code of practice for phosphating iron and steel
25.	IS-5578	Guide for making of insulated conductors.
26.	IS – 11353	Guide for uniform system of marking and identification of conductors and apparatus terminals.

27.	IS – 9482-1980	Characteristics values of input and outputs of single side band PLCC terminals.
28.	IS- 9528 Part-1 and 2	Planning of (single side band) power line carrier systems.
29.	IS – 10706 – 1983	Methods of tests for single side band PLC terminals.
30.	IS-8997-1978	Coupling device for PLC systems (note This is to be referred for the PLCC terminal connections.
31.	IEC-686-1	Transducers
32.	IS – 2206	Fuses
33.	IS – 9000	Dry heat test
34.	IEC – 801-4	Electrical heat transient bursts.
35	IS 694	PVC Insulated cable for working voltage up to & including 1100 volt.

IEC Standards:

Sr.No.	Standard no.	Title
Electromagnetic Compatibility type test:		
1.	IEC-60255-22-1, Class-III,	MHz burst disturbance
2.	IEC-60255-22-2, Class-III IEC-61000-4-2, Class-III	Electrostatic discharge Direct application Indirect application
3.	IEC-60255-22-4, Class-A	Fast transient disturbance
4.	IEC-, 60255-22-5	Surge immunity test
5.	IEC-60255-22-7, Class-A	Power frequency immunity test
6.	IEC-61000-4-8, Class-V	Power frequency magnetic field test
7.	IEC- 60255-22-3	Radiated electromagnetic field disturbance
8.	EN-61000-4-3	Radiated electromagnetic field disturbance
9.	IEEE/ANSI/C37.90.2	Radiated electromagnetic field disturbance
10.	IEC- 60255-22-3	Conducted electromagnetic field disturbance
11.	IEC- 60255-25	Radiated emission
Insulation tests:		
1.	IEC- 60255-5	Dielectric test Impulse voltage test Insulation resistance
Environmental tests:		
1.	IEC-60068-2-1	Cold test Storage test
2.	IEC-60068-2-2	Dry heat test
3.	IEC-60068-2-3	Damp heat test, steady state
4.	IEC-60068-2-30	Damp heat test, cyclic
CE compliance		
1.	IEC- 60255-26	Immunity
2.	IEC- 60255-26	Emissive Test

3.	EN-50178	Low voltage directive
Mechanical tests		
1.	IEC- 60255-21-1	Vibration
2.	IEC- 60255-21-2	Shock and bump
3.	IEC- 60255-21-3	Seismic

ANNEXURE: III

PRINCIPAL TECHNICAL PARAMETERS OF RELAYS / PROTECTIONS

SR. No.	Item	Specification
The protective relay used in panel viz. Feeder / Transformer / Bus-coupler / TBC / Bus Bar shall confirm to the specification for the respective relay mentioned below.		
1.	**DISTANCE PROTECTION**	Main I and Main II Distance Protection shall be of two different make (i.e. from different manufacturers) or of same make with two different platforms with same specifications. The Distance Protection Scheme shall: 1 Be based on principle of impedance measurement. 2 Be numerical type and shall be multi digital signals processor scheme. 3 Be modular in construction. 4 Provide protection for the transmission line from all types of faults, multi phase as well as phase to earth. 5 The protection algorithm shall utilize fault voltages and currents, as well as the superimposed voltages and currents to arrive at a secure trip decision in the shortest possible time with reliability, selectivity and full sensitivity to all types of faults on line. 6 Have non-switched measurement/ Independent measuring loop for all type of faults in each zone, which implies processing of all possible fault loops for each phase. 7 Have shaped quadrilateral / polygonal characteristics to prevent relay operation during max. Load conditions and shall be suitable for short as well as long lines. Selectable mho characteristic for phase fault is preferable depending upon the requirement at the time of technical scrutiny. 8 Have independently adjustable reactive or impedance and resistive reaches for all zone characteristic for maximum selectivity and maximum fault resistance coverage. 9 Have adjustable characteristic line angle.

		10 The relay shall use the memory voltage for proper directional discrimination at close in 3 phase fault which shall be based on positive sequence voltages. The directional discrimination and phase selection based on negative sequence measurement techniques is not acceptable. 11 All the zones shall have setting such that they can detect the fault on line from minimum 0.3 km to 500 km. 12 Have a maximum operating time up to trip impulse to circuit breaker (complete protection time including applicable carrier and trip relay time) with CVT being used on the line for all types of faults anywhere in the protected line section during both max and min generation conditions. a) For SIR 0.01-4, as 40 ms at the nearest end and 60ms at the other end of the line with carrier transmission time taken as 20 ms. b) For SIR 4-15 as 45 ms at the nearest end and 65ms at the other end of line with carrier transportation time taken as 20 ms. c) Isochronic curves shall be provided in support of operating times. 13 Have independent continuously variable time setting ranges for each zone. 14 The maximum fault current could be as high as 50kA but the minimum fault current could be as low as 20% of rated current. 15 The starting and measuring relays characteristics should be satisfactory under these extreme varying conditions. 16 The protective relays shall be suitable for 1A / 5A CT secondary current, selectable at site. 17 The protective relay shall not be affected by CT saturation. 18 Also the relay shall be suitable for use with CVT having non-electronic damping and transient response as per IEC. 19 Have a continuous current rating of two times 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 during a period of 1 sec. 20 It shall be ensured that there is no additional

		delay in relay operating time created intentionally to have stable operation. 21 Numerical full scheme distance protection terminal shall be suitable for use with any communication scheme (permissive under reach, over reach, blocking) and have facility for connection to sub – station control system. 22 The scheme shall have input transformation modules, analogue and digital filters, processing units, A/D and D/A converters, DC supply modules etc. 23 The sampling rate of analogue inputs, the processing speed and processing cycle of digital values shall be selected so as to achieve the operating time specified. 24 Be capable of performing basic instrumentation functions and display on demand of various measured parameters like voltage, current, active power, reactive power, etc. in primary values. Additionally, all sequence current and voltage values, direction of power flow, alarms and clock, relay identification, settings etc. during normal as well as fault conditions on individual phase basis shall be displayed on line. Pre fault and fault values of current and voltage must be available for fault analysis purpose. 25 Have a MMI (Man Machine Interface) in the front of relay comprising of a 2-3 line alphanumeric LCD display. 26 Facilities shall be available through a soft touch keypad on the MMI for setting alteration, display of all settings, scheme logics and any other requirements as per the software and hardware configuration of the system other than the menu driven alarms. 27 Have a front/rear RS 232 – Communication part for use with a PC locating for local access to settings, events and records. 28 Have one rear communication port on fiber optic medium or remote communication based on RS 485 connectivity to support (1) all the facilities available via the integral user interface and (2) facilities supported under IEC-61850-8-1 interface. 29 Shall be provided with standard protocols and changing of protocols must be possible at a later date depending on future communication

		requirement. 30 Have mutual zero sequence compensation factor setting. The relay shall have facility to select different group settings to cater for mutual coupling on account of multi circuit line conditions. The minimum no. of group should be four. 31 Be suitable for 110 or 220 volt DC supply. The relay shall have suitable DC to DC converter. DC voltage range of ±20% & harmonic level is max 2% at rated value. 32 Have resetting ratio more than 105% and resetting time of typical 30 ms. 33 Operate instantaneously for a close-in three-phase fault and switch on to fault. 34 Be suitable for single and three phase tripping. 35 Be selective for internal and external faults. 36 Include power swing blocking feature which shall: a) Have separate measuring element for power swing detection. b) Have fast detection of power swing. c) Shall be on the principle of measurement of the rate of impedance vector change and monitoring of the vector path. d) Have selective blocking of zones. e) Have settable unblocking criteria for earth faults, phase faults and three phase faults. f) Have the Earth fault detection feature, which shall over ride power swing blocking and allow the relay to operate for trip as per zone detection. g) The relay shall be blocked for the set time for the first PS sensed and remain unblocked for the set time for the successive PS. 37 Include fuse failure protection/ Loss of voltage feature which shall: a) Monitor all three phase fuses of capacitance / electro-magnetic voltage transformer and associated cables against open circuit. b) Inhibit tripping on sudden total loss of voltage or one/two fuse fail condition and initiate annunciation. c) Have an operating time less than 7 ms. d) Remain operative for system earth fault.

		38 Have minimum 06 no. of heavy duty contacts on trip relays to provide for energizing two trip coils of each of the main and TBC breaker through the two separate DC source. 39 Have at least 24 no. of programmable binary input and 32 no. of programmable binary output contact to cater for DR/SER carrier aided tripping auto re-closing etc. 40 Have built in supervision and testing facility including continuous DC supply supervision. 41 Be provided with a continuous self-monitoring and diagnostic unit to give alarm in case of abnormalities and locate defective units immediately. Self-monitoring should cover microprocessor, EPROM contacts, measuring elements, battery status and all associated program. 42 Include built-in distance to fault locator with features as below. a) An accurate fault locator is an essential complement to the line protection. It shall have an accuracy of 3% or better for all types of faults and fault levels. b) It shall provide digital indication of distance to fault in percentage of the supervised line length of kilometers or in kilometers directly without requiring further calculations. c) It shall provide distance to the fault together with information about the measuring loop that has been used in the calculations. d) Information of the last 08 disturbances should be available. e) The fault locator algorithm compensates the effect of the load currents, the apparent fault resistance and zero sequence mutual impedance. f) It shall meet IEC-255 or other equivalent recognized standards. g) It shall be suitable for breaker operation time of 2 cycles. h) The above accuracy shall not be impaired under the following conditions. i Presence of remote end in feed. ii Predominant DC components in fault current. iii High fault Arc resistance. iv Severe CVT transients.

		43 Conditional accessories shall not be acceptable. 44 Be supplied along with all suitable Original Customized licensed software & communication cable for local and remote communications, analysis of fault etc. 45 Have reset push button on front panel board. 46 Have provision of Broken Conductor Detection / protection with alarm/trip facility to detect open conductor condition by way of level detector or negative sequence measurement. 47 Have built in an independent directional/non-directional (selectable) Earth fault protection element to detect highly resistive faults. This element shall have IDMT characteristic with a definite minimum time of 3.0 sec. at 10 times setting and shall have variable setting range of 20-80% of rated current and characteristics angle 45 degree lag. 48 Have directional/non-directional (selectable) back up over current function in built. This element shall have IDMT characteristic with a definite minimum time of 3-0 seconds at 10 times setting having a variable setting range of 50-200 % rated current and a characteristic angle of 45 degree lead. 49 Provide protection against short circuit and interruption in the secondary wiring of the V.T supply circuit supplying the relay. 50 Have Disturbance recording facility, which records a minimum of 08 analogue channels (phase and residual values) and a minimum of 32 digital programmable digital channels, which shall include various digital inputs, output relays and internal digital signals. The facility must be capable of recording at least 10 disturbances. The duration of record shall be settable and be adequate to capture maximum possible information and be bifurcated in pre-fault & post-fault time. Necessary software shall be provided for retrieving and analyzing the records. 51 Have sampling rate of minimum 12 samples/ cycle to capture disturbance parameters faithfully. 52 Have programmable threshold values for each analog channel for over/under value triggering. 53 Be compatible with GPS time synchronizing facility via IRIG-B DC (Unmodulated).

		54 Have additional protection functionality over and above mentioned earlier such as: a) Current reversal and weak end infeed protection logic. b) SOTF feature. c) Over / under voltage protection. d) Breaker failure protection. e) Dead line Detection. f) Auto re-closure with synchro-check facility. 55 Have non volatile storage of DR & SER and also have real time clock buffered by Battery or any other suitable means. In case of Battery; it shall be reliable and long lasting. There shall be an alarm and indication for declining battery status. 56 Auto re-closing feature shall be included in the Numerical Distance Protection Scheme as a built-in feature. It shall a) Have single phase and three phase re-closing facilities b) Have a continuously variable single phase dead time of 0.5 to 5 seconds c) Have continuously variable three phase dead time range of 0.5 to 5 seconds. d) Have a continuously variable reclaim time range of 5-25 seconds e) Incorporate a four-position selector switch from which single phase/three phase/single and three phase/auto re-closure and non-auto re-closure mode can be selected f) Have facilities for selecting check synchronizing or dead line charging features. It shall be possible at any time to change the required feature by reconnection of links. g) Be of multishot type h) Include check synchronizing relay which shall i Have a time setting variable between 0.5 to 5 seconds. ii Have a response time within 200 ms with the timer disconnected. i) Include dead line charging relay. j) Incorporate necessary auxiliary relays and timers to give comprehensive scheme. k) Incorporate a separate pole discrepancy relay with timing range of 0.1 to 1 sec l) Auto re-closure of the line shall take place only when fault is cleared in first zone by the main protection.

		m) Incorporate auto re-closure lockout features to prohibit auto re-closure under the following conditions. i Tripping due to operation of bus bar protection. ii Tripping immediately after the manual closer of line breaker. iii Tripping for faults in 2nd and 3rd zone as backup. iv When tripping takes place after a power swing condition. v In the event of trip on pole discrepancy. vi When carrier is out of service. n) It should have positive phase selections under all operating conditions. The scheme should be such that shut down and testing on one Main protection should not affect the other Main protection. The auto re-closure should then be connected to the other Main protection. o) Come in to operation with distance protection when these protections operate for Zone-I fault and trip the breaker. 57 **Built in Local breaker backup protection scheme shall:** a) Comprise of a breaker failure initiating relay, 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. b) The operation of both breaker failure initiating relay and breaker failure relay will initiate timer relay which in turn operates lockout relay. The lockout relay will have N/O contacts for annunciation and for energisation of bus bar protection trip relays (available on bus bar protection panels procured separately) for tripping all the other breakers connected to the bus c) Breaker failure relay scheme above shall: i Be triple pole type. ii Be suitable for 110 or 220 V DC supply. iii have an operating time of less than 15 ms. iv have a resetting time of less than 15 ms. d) Have necessary auxiliary relays to make a comprehensive scheme. The scheme shall be so engineered that in the event of persisting breaker lockout condition and simultaneous

		incidence of fault shall result in instantaneous tripping of the concurred bus bar to which the faulty breaker is connected. **<u>Technical Parameters</u>** **Power supply module** a) Aux. DC Voltage - 110/220 V DC b) Permissible tolerance - ± 20% c) Power consumption - 15 to 40 W **Analog inputs** a) Current - 1 A CT < 0.5VA b) AC voltage - 110V PT, < 0.5VA c) Permissible overload - CT 4A cont. PT 230V Cont. d) Frequency - 50 Hz, ± 5% **Distance protection Zones** a) No. of zones - Five, selectable direction b) Characteristic - Quadrilateral and/ or mho (selectable) c) Minimum operate current - (10-30)% of In d) Xp Setting Range - 0.5 to 250 Ω/Ph e) Rp Setting Range - 0.1 to 250 Ω/Ph f) Xo Setting Range - 0.5 to 250 Ω/Ph g) Ro Setting Range - 0.5 to 250 Ω/Ph h) Angle - 10^0 to 85^0 i) Zone timers - 0 – 30 s, ± 10 ms j) Operate time - @ 25 ms k) Reset ratio - 105% for DPR 95% for SOTF l) Reset time - 40 ms **Binary inputs Module** a) Binary inputs - 24 (freely assignable to any function) b) DC Voltage - 110/125 V DC, ± 20% 220/250V, ± 20% c) Power consumption - Max 0.2 W/Input-110V Max 0.4 W/Input-220V **Binary output module** a) Binary outputs - 32 (Programmable) b) Max system voltage - 250V, AC/DC c) Test voltage across open circuit 1 min - 1000V rms d) Current carrying capacity- Continuous – 5A

For 1 sec – 10 A

e) Making capacity at inductive load - 0.2s – 30 A, 1.0s – 10 A

f) Breaking capacity for AC - 250V/8.0A

g) Breaking capacity for DC with L/R < 50 ms - 25 VA

Synchro-check and energizing check

a) Shall initiate on: Auto re-closure
Manual CLOSE control
Control Commands

b) Operating Modes: Synchro-check
Line Dead/ Bus Live
Line Live/ Bus Dead
Line and Bus Dead
Bypassing

c) Phase angle difference 5 to 80^0
Between bus and line

d) Voltage difference 2 to 10% of nominal voltage.

e) Reset ratio Synchro-check > 95%

f) Frequency diff. Limit 0.03 to 1.000 Hz
Between bus and line.

g) Time delay 0 to 30 s

Auto re-closure

a) Operating Mode Only 1-Pole,
Only 3-Pole,
1 or 3-Pole

b) No. Of auto re-closing shots Minimum 3

c) Dead Time 0.5 to 5 sec

d) Reclaim Time 5 to 25 sec

<u>Measurements</u>

Function	**Range**	**Accuracy**
Frequency	0.95 to 1.05 x fn	± 2.0 m Hz
Voltage	0.1 to 1.5 x V	± 1.0 %
Current	0.2 to 3.0 x In	± 1.0 %
Phase angle	0 to 360 deg	± 2.0 deg.
Power(P,Q and S)	within specified current and Voltage range, Accuracy ± 2.0% of Apparent power.	
Power factor	Within specified current and Voltage range, Accuracy ± 2.0 deg.	

		Disturbance report a) Pre fault time (0.05 – 30.0)s b) Post fault time (0.1 – 5.0)s c) Limit time (0.5 – 6.0)s d) Min. no. of recordings 10 e) Time tagging resolution 1 ms **Communication Protocols** • IEC-61850-8-1 **Remote communications** a) Type of fiber – Graded-index multi core 62.5/125μm b) Wave length – 820 nm c) Transmission distance – 0-3 Km d) Optical connector – Type ST e) Data transmission – Synchronous f) Transmission rate – 64 K bit/ s **Time synchronization** a) Format IRIG-B **Temperature and humidity** a) Ambient temp -10 to 55 ° C b) Relative humidity 10% to 90% Non Condensing c) Operate range 0-95% d) Storage temp. -40 to 70 ° C **Water and dust protection level according to IEC-60529** Front – IP40 (IP54 with sealing strip) Rear – IP20 Sides – IP40 Top and bottom – IP30 **CT&VT CONNECTIONS** Type - Terminal block Range – 250V AC,20A Max. conductor area – 4 sq. mm **Binary I/O connections** Rated voltage – 250V AC Max. conductor area – 2.5 sq. mm, 2x1 sq. mm
1A	**Line Differential**	Main I and Main II Line Differential Protection shall be of two different make (i.e. from different

	Protection	manufacturers) or of same make with two different platforms with same specifications. The relay shall have all the features as per Distance protection relay over and above following features 1. It shall be working on phase segregated current Differential protection principle. 2. It shall have multiple slope characteristic (preferably) to have stability against CT saturation and heavy through faults as well as sensitivity for internal faults. 3. It shall measure Differential as well as restrain current continuously and shall display the same as measurement. 4. It shall use fiber optic cable or multiplexed digital network to exchange telegrams. 5. It shall communicate to remote end through IEEE C37.94 format. 6. It shall have redundant communication channels for protection communication. 7. It shall communicate analogue as well as digital signals to remote end. 8. It shall have various communication options for remote communication i.e. mono-mode / multi-mode for direct communication / communication through multiplexer. 9. It shall have Line charging current compensation feature for better sensitivity. 10. Distance protection function can be utilized as independent or as back up of Differential protection in case of failure of remote communication. 11. It shall communicate time coordinated current signals for remote communication to execute Line differential protection algorithm accurately. Time synchronization through GPS shall also be possible. 12. It shall monitor individual communication links continuously and switchover to standby link after preset time in case of failure of one link. 13. It shall supervise individual telegrams. 14. It shall detect reflected telegrams. 15. It shall detect change in communication delay time. 16. It shall measure delay time for remote end along with dynamic compensation of the same in

		differential protection algorithm. 17. It shall also supervise maximum permissible delay time. 18. It shall generate alarm for heavily disturbed communication link. Technical Parameters A. Line Differential Protection setting: 1. Minimum operating current - 20 to 200% of In 2. Slope (Single/dual) - 10 to 100% 3. End section (Single/dual) - 20 to1000% of In 4. Highset operating current - 100 to 5000% of In 5. 2 nd Harmonic blocking - 5 to100 % 6. Typical operating time - 25 ms 7. Operating time for high set - 15 to 20 ms 8. Charging current comp. – Selectable B. Remote communication: 9. Analogue signal transfer – Minimum 3 Nos. 10. Binary signal transfer - Minimum 8 Nos 11. Remote Communication module Dual modules suitable for a) 1300 nm - multi-mode OR b) 1300 / 1550 nm – mono-mode (finalized during detailed engineering 12. Synchronization mode - GPS / Echo (finalized during detailed engineering) 13. Time delay alarm - 5 to 500 ms, step 5 ms (for communication fail) 14. Time delay - 5 to 500 ms, step 5 ms (for switching to redundant channel) 15. Asymmetric delay - - 20 to +20 ms, step 1 ms (When echo mode is used) 16. Max. Transmission delay – 0 to 40 ms, step 1 ms
2	**Backup Impedance PROTECTION**	The relay shall 1) Be triple pole type with faulty phase identification / indication. 2) Have single zone under impedance relay suitable for phase/phase and phase to ground fault with MHO characteristic. AC - V 110 Phase – Phase AC - I 1amp.

		3) Have impedance setting 50-300 ohms with suitable taps to set 60 – 80 % of reactor impedance with E/F compensation of 50-100%. 4) Have timer 0-2 sec. continuously adjustable. 5) Have an adjustable characteristic angle of 30-85 degree. 6) Provide sufficient number of potential free contacts to cater the needs of connection to alarm annunciation. Data acquisition and optional trip facility to be connected by purchaser where needed. 7) Be numerical type. 8) Be auxiliary DC voltage operated not self power relay. 9) Include VT failure relay which shall block the tripping during VT fuse failure condition.
3	**Directional O/C & E/F PROTECTION**	**(A) Features:** a) Shall be Numerical type. b) Shall have 2 over current and 1 Earth Fault element. c) TRUE RMS Measurement. d) Have selectable and front panel programmable normal inverse, very inverse, extremely inverse & long inverse IEC/ANSI Characteristic. e) Selectable CT Secondary. I.e. 1A / 5A f) High set over current with selectable time delay. g) High set Earth fault with selectable time delay h) Have adjustable characteristic angle, lead/ lag, for Directional over current/ Earth Fault respectively. i) Suitable to decide directionality through zero sequence quantity and through external open delta voltage input as an optional in case of Directional Back up relays. j) Shall have in built Breaker Failure Protection. k) Include hand reset Flag/LED indicators for fault. l) Readable Human Machine Interface with LCD display. m) Should be able to store at least last 3 fault records viz. Fault current, Faulty Phase etc with time stamp. n) Shall have Disturbance Recording facility for minimum 3 sec for each fault. o) Self monitoring. p) Relay offered shall be communicable type. q) Be supplied along with all suitable Original Customized licensed software & communication cable for local and remote communications, analysis of fault etc

		(B) Technical Parameters: 1. Rating: 1A / 5A, 50 Hz ±2.5 Hz 2. Auxiliary Supply: 110/220 V DC ±15 % **(C) Relay settings:** 1. Over Current: 50% - 200% (In steps of 5%) 2. Earth Fault: 5% - 80% (In steps of 5%) 3. High set O/C: 0.5 – 15 times In or more. 4. High set E/F: 0.5 – 12 times In or more. 5. Time multiplier for IDMT: 0.05 – 1.0 (In steps of 0.025) (Independent for O/C & E/F) 6. Time delay for high set element : 0.02 to 2 sec (in steps of 0.01 sec) 7. Pick up: Within 1.1 times of set current value. 8. Reset current: 95% to 90% of pick-up current. 9. Operating Time: As per selectable characteristic. For Inst. Element < 40 ms for 2xIn. **(D) Other Features:** 1. **Binary inputs**: Min 8 nos. and suitable for Station Aux DC. 2. **Outputs**: • Output contacts: Minimum 2 N/O contacts with - Continuous carry 5 A - Make & Carry for 0.5 s 30 A - Make & Carry for 3.0 s 15 A • Binary Output: Minimum 6 Nos. and suitable for Station Aux. DC (Programmable at site) 3. **Communication**: • RS232/RS485, Fiber optic ports • IEC 60870-5-103 protocol / • IEC 61850 protocol • Time Synchronization: IRIG B port 4. **Housing** • Flush Mounting • Screw Terminals (‘O’ Lug for CT Connection) • Degree of Protection IP54 5. **Temperature and humidity** (a) Ambient temp -10 to 55 ° C (b) Relative humidity 10% to 90% Non Condensing (c) Operate range 0-95% (d) Storage temp. -40 to 70 ° C

4	**Non-Dir. O/C & E/F PROTECTION**	**(A) Features:** r) Shall be Numerical type. s) Shall have 2 over current and 1 Earth Fault element. t) TRUE RMS Measurement. u) Have selectable and front panel programmable normal inverse, very inverse, extremely inverse & long inverse IEC/ANSI Characteristic. v) Selectable CT Secondary. I.e. 1A / 5A w) High set over current with selectable time delay. x) High set Earth fault with selectable time delay y) Shall have in built Breaker Failure Protection. z) Include hand reset Flag/LED indicators for fault. aa) Readable Human Machine Interface with LCD display. bb) Should be able to store at least last 3 fault records viz. Fault current, Faulty Phase etc with time stamp. cc) Shall have Disturbance Recording facility for minimum 3 sec for each fault. dd) Self monitoring. ee) Relay offered shall be communicable type. ff) Be supplied along with all suitable Original Customized licensed software & communication cable for local and remote communications, analysis of fault etc **(B) Technical Parameters:** 1. Rating: 1A / 5A, 50 Hz ±2.5 Hz 2. Auxiliary Supply: 110/220 V DC ±15 % **(C) Relay settings:** 1. Over Current: 50% - 200% (In steps of 5%) 2. Earth Fault: 5% - 80% (In steps of 5%) 3. High set O/C: 0.5 – 15 times In or more. 4. High set E/F: 0.5 – 12 times In or more. 5. Time multiplier for IDMT: 0.05 – 1.0 (In steps of 0.025) (Independent for O/C & E/F) 6. Time delay for high set element : 0.02 to 2 sec (in steps of 0.01 sec) 7. Pick up: Within 1.1 times of set current value. 8. Reset current: 95% to 90% of pick-up current. 9. Operating Time: As per selectable characteristic. For Inst. Element < 40 ms for 2xIn.

		(D) Other Features: 1. **Binary inputs**: Min 8 nos. and suitable for Station Aux DC. 2. **Outputs**: • Output contacts: Minimum 2 N/O contacts with - Continuous carry 5 A - Make & Carry for 0.5 s 30 A - Make & Carry for 3.0 s 15 A • Binary Output: Minimum 4 Nos. and suitable for Station Aux. DC (Programmable at site) 3. **Communication**: • RS232/RS485, Fiber optic ports • IEC 60870-5-103 protocol / • IEC 61850 protocol • Time Synchronization: IRIG B port 4. **Housing** • Flush Mounting • Screw Terminals ('O' Lug for CT Connection) • Degree of Protection IP54 5. **Temperature and humidity** (a) Ambient temp -10 to 55 ° C (b) Relative humidity 10% to 90% Non Condensing (c) Operate range 0-95% (d) Storage temp. -40 to 70 ° C
5	**% BIASED DIFFERENTIAL PROTECTION**	**A) Differential % BIASED protection** i). Be high speed with an operating time of less than 30 ms at 5 times the rated current. ii). Shall be numerical type and **Shall have high set feature and Dual Bias Characteristics** iii). True RMS Measurement. iv). Shall have continuous self monitoring and diagnostic features. v). Be suitable for three phase auto star/ non auto two/ three winding transformer. vi). Be stable on heavy through faults. vii). Be immune to magnetizing inrush current. viii). Have features to provide stability under over excited conditions and have 2nd and 5th harmonic restraint features.5th harmonic bypass is not acceptable. ix). Be triple pole type with faulty phase identification/ indication. x). Have internal features in the relay to take care of the angle and ratio correction. xi). Shall have the following functions. i. Differential Protection

		ii. Restricted Earth Fault Protection iii. Thermal Over Load Detection iv. Over Fluxing Protection v. LBB xii). Provide sufficient number of potential free contacts to cater the needs of connection to alarm annunciation. Data acquisition and optional trip facility to be connected by purchaser where needed. xiii). Be supplied along with all suitable Original Customized licensed software & communication cable for local and remote communications, analysis of fault etc. xiv). Have a local user interface (MMI) comprising of a 2-3 line alphanumeric LCD display and a soft touch key pad to access the settings, events and records in the relay. xv). Have a front RS 232 communication ports for use with a PC locally for local access to settings, events and recorders. xvi). Have two rear communication ports on fiber optic/twisted wires for remote communication based on RS 485 connectivity to support (1) all the facilities available via the integral user interface and (2) facilities supplied under IEC – 61850 interface. vii). Have a disturbance recording feature to record graphic form of instantaneous values of current in all three windings in nine analog channels during faults and disturbances for the 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 relays. a. REF protection operated b. HV Each Breaker pole status i.e. 3 no. inputs c. LV Each Breaker pole status i.e. 3 no. inputs. d. Buchholz / OLTC Buchholz alarm / trip i.e. 4 no. inputs. e. WTI/OTI/PRV alarm /trip of transformer. Necessary hardware and software for down loading the data captured by disturbance recorder to the personal computer available in the sub station shall be included in the scope. **B) <u>OVER FLUX FEATURE</u>** i). Operate on the principle of voltage to frequency ratio and shall be phase to phase connected. ii). Have inverse time characteristics, matching with transformer over fluxing withstand capability curve.

		iii). Provide an independent `alarm' with the time delay continuously adjustable between 0.1 to 6 seconds. iv). Tripping time shall be governed by v/f vs. time characteristic of the relay. v). V/F setting shall be adjustable from 1.0 to 1.5 times rated flux. vi). Have a set of characteristics for various time multiplier settings. The maximum operating time of the relay shall not exceed 3 seconds and 1.5 seconds at `V/F' values of 1.4 and 1.5 times of rated values respectively. vii). have an accuracy of operating time, better than ± 10% Have a resetting ratio of 95% or better, rated voltage 110V AC. 50Hz. viii). Provide sufficient number of potential free contacts to cater the needs of connection to alarm annunciation. Data acquisition and optional trip facility to be connected by purchaser where needed. Includes hand reset LED for Alarm & Trip operated indication. **C) REF feature** i). Be single pole type ii). Be high impedance differential protection **(Necessary stabilizing resistor and voltage limiting non-linear resistor shall be provided)** iii). Be high speed circulating current type iv). Be tuned to the system frequency v). Be high speed with typical operating time of less than 30 ms vi). Be stable for through fault **D) Breaker failure feature** i). Shall provide back up protection when primary breaker fails to operate by isolating all breakers connected to faulty breaker bus. ii). Shall initiate tripping on persisting breaker lock out condition and simultaneous incidence of fault. iii). Be high speed with typical operating time of less than 30 ms **<u>Technical Parameters</u>:** 1. Rating: 1A / 5A, 50 Hz ±2.5 Hz 2. Auxiliary Supply: 110/220 V DC ±15 % **Differential protection settings:** 3. Diff. Current: 10% - 50% (In steps of 5%) 4. Diff. High Current 2 – 10 times In (In steps of 1)

		5. Bias Diff Current 10% - 50% (In steps of 5%) 6. Bias slope limit 10 times 7. 2nd Harmonic Restraint ratio 10 to 80% 8. 5th Harmonic Restraint ratio 10 to 80% **Over Excitation Function settings:** 9. V/f Alarm. 1.05 to 1.20 (step 0.01) 10. Time delay for alarm 0 to 60 s (step 0.01) 11. Characteristic Values V/f 1.05 to 1.50 (step 0.05) IDMT characteristic 12. Time delay for each V/f 0 to 20000 sec (step 1 s) **REF protection settings** 13. Differential current 0.1 to 1 A **Breaker failure protection settings** 14. current range 0.05 to 1 A in steps of 0.05 In 15. Time Delay 0 to 800 ms In steps of 10 ms 16. Breaker status monitoring Binary I/P for each pole **Thermal over load protection** 17. Rated thermal current 0.5 to 2.5 In 18. Thermal alarm 50 to 200% In 19. Current alarm 50 to 200% In **Other Features:** 20. **Binary inputs**: Min 20 nos. and suitable for Station Aux DC. 21. **Outputs**: • Trip contacts: Minimum 2 N/O contacts with - Continuous carry 5 A - Make & Carry for 0.5 s 30 A - Make & Carry for 3.0 s 15 A • Output Relay: Minimum 10 Nos. and suitable for Station Aux. DC (Programmable at site) 22. **Communication**: • RS232/RS485, Fiber optic ports • IEC 61850 protocol • Time Synchronization: IRIG B port 23. **Housing** • Flush Mounting • Screw Terminals (‘O’ Lug for CT Connection) • Degree of Protection IP51 24. **Temperature and humidity** (a) Ambient temp -10 to 55 °C (b) Relative humidity 10% to 90% Non Condensing (c) Operate range 0-95% (d) Storage temp. -40 to 70 °C

6	**RESTRICTED EARTH FAULT PROTECTION (R.E.F. PROECTION)**	High impedance differential protection. The relay shall be suitable for rated current of 1 amp & have suitable D.C/D.C converter suitable for 110 / 220 V D.C. (Preferably 88V TO 300V D.C.). DC voltage range of – 15% to + 25% harmonic level is max, .2% at rated value. 1) Be single pole type 2) Be of numerical type 3) Be high speed circulating current type 4) Have current setting of 10-40% of rated current. 5) Be tuned to the system frequency. 6) Shall provide stability against through fault. 7) Be suitably protected against high voltages. 8) Have alarm and trip output contacts. 9) Have a local user interface (MMI) comprising of a 2-3 line alphanumeric LCD display and a soft touch key pad to access the settings, events and records in the relay. 10) Includes hand reset flag/LED phase wise indicator. 11) Be high speed with typical operating time of less than 25 ms. With provision of high set differential current 5-10 times. 12) Provide sufficient number of potential free contacts to cater the needs of connection to alarm annunciation. Data acquisition and optional trip facility to be connected by purchaser where needed. 13) Be supplied along with all suitable Original Customized licensed software & communication cable for local and remote communications, analysis of fault etc
7	**AUXILIARY RELAYS FOR TRANSF TROUBLES.**	(1).Buchholz trip. – 1no. (2).Buchholz alarm --- 1 no. (3).OLTC Buchholz trip. --- 3 no. (4).Oil temperature trip. ---2 no. (5).Oil temperature alarm. – 2 no. (6).Winding temperature trip. --- 2 no. (7).Winding temperature alarm. --- 2 no (8).P.R.V. trip. --- 3 no. (9).Deluge valve operated -- 2 no. (10). Low oil level alarm – 1 no. (11). Cooling system trouble alarm. ---1 no. (12). Spare-2nos. (13). Provide sufficient number of potential free contacts to cater the needs of connection to alarm annunciation, Data acquisition and optional trip facility to be connected by purchaser where needed.
8	**HIGH SPEED TRIP (FEEDER / ICT / BC / TBC**	As per the system design sufficient relays having potential free contacts for (lock out) trip circuit 1 & 2 of main breaker and TBC. The contacts for trip circuit shall be Heavy Duty.

		1) Provide sufficient number of potential free contacts to cater the needs of connection to alarm annunciation. Auto re-close relay, LBB relay, DR/SER Data acquisition and optional trip facility to be connected by Purchaser where needed. 2) It shall be instantaneous with operating time less than 10 ms. It shall have 18NO & 2NC Electrical resetting type contacts. It shall be 220/110V DC operating and preferably provided with single coil. 3) Be provided with operation indicators.
9	**SUPERVISION RELAY FOR HIGH SPEED TRIP RELAY (FEEDER/ICT/BC /TBC**	Coil supervision relay shall be provided for all high speed trip relays. The relay shall 1) Monitor the complete coil circuit for both the trip relays i.e. Gr. A & Gr. B. 2) Monitor loss of battery supply 3) Have a delay on drop off 4) Provide alarm output 5) Include hand reset flag indicator 6) Provide sufficient number of potential free contacts to cater the needs of connection to alarm annunciation. Data acquisition and optional trip facility to be connected by purchaser where needed.
10	**TRIP CIRCUIT SUPERVISION RELAY (FEEDER / ICT / BC/ TBC**	Trip circuit supervision relay shall be provided for each pole of the breaker for both trip coils with separate DC source. The relay shall a) Monitor the complete trip circuit with circuit breaker in pre-close & post-close condition. b) Monitor loss of battery supply. c) Have a delay on drop off d) Provide alarm output. e) Include hand reset flag indicator. f) Provide sufficient number of potential free contacts to cater for DR / SER.
11	**DC SUPPLY SUPERVISION RELAY**	The relay shall be capable of monitoring the failure of D.C supply to which it is connected. It shall have adequate potential free contacts to meet the scheme requirement. The relay shall have a time `delay on drop-off' of not less than 100ms. And be provided with operation indicator/flag.
12	**PT SELECTION RELAY**	The necessary PT selection relay shall be provided for line/bus voltage selection. It shall be provided with sufficient contacts for selected P.T. to protection and metering circuits and D.C permissive to protection. The relay should be latched type and operating and resetting coils. The relay shall have clear visible indication flag/LED.
13	**BUS BAR PROTECTION**	Numerical Bus Bar Protection scheme shall cover all the main and auxiliary buses and circuits. Numerical Bus Bar Protection scheme shall have the following features.

		a) It shall be a Numerical Bus Bar Protection scheme. b) Operate selectively for the bus bar faults. c) Include protection in / out switch. d) Provide 100% stability up to 50KA fault level. e) Be low impedance biased differential type and shall have operate and restrain characteristics. f) The scheme shall have 2 nos. of spare bay units over and above the required bay units as per substation lay out. The no. of bays at the respective sub station shall be collected from the purchaser. g) Be inoperative for through faults, but shall operate correctly and positively for faults within the protected zone(s) even under condition of CT saturation. h) Operate selectively for each zone of bus bars for all type of faults, phase to phase or phase to ground faults even for high resistive faults. i) Have maximum operating time of 20 to 30 ms, including trip relay, for all type of faults. j) Incorporate continuous supervision for CT secondary against any possible open circuit and if it occurs shall render the relevant zone of protection inoperative and provide an alarm output. k) The Bus bar Protection shall have a centralized structure comprising a Central Unit and an appropriate number of Bay Units. All the Bay Units shall be located in a common station protection panel and the Central Unit in another station protection panel. l) The secondary of the bay CT's shall be connected directly to the respective Bay Unit. Ratio correction shall be through software means. External auxiliary CT's shall not be used in the connections to the Bay Units for compensating different CT ratios. m) Filtering and evaluation of the analogue quantities (bay level currents) shall be performed in the Bay Units. The Central Unit shall evaluate the differential currents for each phase and for each zone. The tripping contacts on the Bay Unit shall be directly wired to trip the respective bay breaker which may have

			one or two trip coils. The contacts should be of adequate rating.
		n)	The Bay Units shall be connected to the Central unit by means of fiber optic cables. The communication between the Bay Units and the Central Unit shall be effected by means of a deterministic protocol. In case of any interruption in the communication between the Central Unit and any Bay Unit, the corresponding zone shall be blocked. An alarm shall also be given.
		o)	The normally open and normally closed auxiliary contacts of the isolators of each bay shall be connected to the respective Bay Unit. The Bay Units shall send the information regarding the positions of the isolators to the Central Unit at regular intervals and the image of the bus bar shall be formed in software form in the Central Unit. External relays shall not be used for forming the image of the bus bar.
		p)	The normally open (NO) and normally closed (NC) auxiliary contacts on each isolator shall be used for selection of bus bar zones.
		q)	No CT switching relays shall be used for connecting correct CT inputs to the protected zone. If both isolators of a particular bay are closed, an audible isolator alarm shall be given and the bus bar zones should act as single zone. This monitoring of the integrity of the isolator auxiliary contacts shall be performed in software form without the use of external relays and timers.
		r)	To enhance security, the Bus bar Protection scheme shall have two independent measurements and tripping criteria. A trip signal shall be initiated only if both criteria are simultaneously satisfied. Neither criterion shall be voltage dependent.
		s)	Preferably, these two criteria shall be the stabilized differential current and the phase (directional) comparison of currents in the different bays.
		t)	The Bus bar Protection shall be insensitive to transients and harmonics and be fully reliable and selective even under CT saturation conditions.
		u)	The Bus bar Protection shall be capable of

			operating with CT's of widely different ratios with different rated secondary currents. The matching of CT ratio in each bay shall be done by a simple setting via the HMI without the use of external auxiliary CT's.
		v)	The numerical bus bar protection shall be with extensive self-supervision and diagnostic facilities.
		w)	The HMI program should graphically display the bus bar configuration and the bus bar image. The HMI program shall facilitate setting of the protection and read out of various information such as bus differential current in each zone, phase currents (and voltages in each bay), positions of the isolators & breakers, etc. The HMI program shall also permit dialogue with the protection from a remote location without the need for additional software. The HMI program should be based on MS Windows environment.
		x)	The HMI program shall facilitate free assignment of the optocoupler inputs and signal relay / trip relay outputs to a given list of inputs and outputs. It shall be possible to program the output relays to be of the latched or non-latched type.
		y)	The redundant features available shall include redundant power supply module for the Bay Units & the Central Unit and a second input/output card for the Central Unit.
		z)	The system shall, preferably, as options, permit inclusion of additional functions such as independent Over Current Protection at the bay level, trip re-direction, pole discrepancy detection and where required, under voltage/ over current release for Bus bar Protection.
		aa)	The Bus bar Protection shall include a Disturbance Recorder function in each Bay Unit which shall record the bay phase currents. The sampling frequency of this Disturbance Recorder function shall be selectable from 2400 Hz, 1200 Hz or 600 Hz. The recording period shall be at least 1.5 seconds. The system shall, preferably, as an option, permit recording of bay level voltages as well.
		bb)	The Bus bar Protection shall also include an Event Recorder function. The Event Record

		buffer in the Central Unit shall accommodate at least 1000 events while that in each Bay Unit shall accommodate at least 100 events. cc) The Disturbance Recorder and Event Recorder buffer memory shall be of non-volatile type and shall not require the use of batteries. dd) When the bus tie breaker is equipped with one set of CT's only and when the bus tie breaker is in open position, the Bus bar Protection shall exclude this CT in the evaluation of the Bus bar Protection measurement. This will ensure that, when the bus tie breaker is in open position and a fault occurs between the CT and the bus tie breaker, the faulted bus section is selectively tripped and isolated without any delay. The healthy bus section will not be tripped. ee) A Local Display Unit (LDU) shall be provided on the Central Unit and on each Bay Unit. ff) The LDU on the Central Unit shall permit read out of the following information: • Differential currents in each Bus bar zone and each phase • Alarm conditions • Trip conditions • State of all the inputs and outputs in the Central Unit • Setting values • Phase currents (and optionally, phase voltages) in each bay • State of all the inputs and outputs in each bay • Positions of the isolators in each bay • Positions of the breakers in each bay • Setting values • Resetting of output relays gg) The LDU on each Bay Unit shall permit read out of the following information: • Phase currents (and optionally, phase voltages) in each bay • Alarm conditions • Trip conditions • State of all the inputs and outputs in the respective bay • Positions of the isolators in the respective bay

		• Position of the breaker in the respective bay • Setting values • Resetting of output relays hh) Provide sufficient number of potential free contacts to cater the needs of connection to alarm annunciation. Data acquisition and optional trip facility to be connected by purchaser where needed. ii) Shall have immunity against system transients. jj) Include continuous DC supply supervision. kk) Incorporate clear zone indication. ll) Should not operate during the change over operation of a circuit from one bus to another bus and during normal load flow in bus bars. mm) Trip both the breakers i.e. the breakers being bypassed and the transfer breaker if the bus fault occurs during the change over operation. nn) Have provision to reset trip bus through a single push button to be provided for the purpose. oo) It shall be possible to prepare the Bus bar Protection to include, in the protection scheme, future bays as and when they are added. In such cases, the system shall be easily extendable by adding Bay Units for the new bays and activating the same in the Bus bar Protection. Such extension work shall not require any other wiring changes to the existing system. pp) The bus bar protection offered shall have communication port for integrating with the local station automation or to a station monitoring system. One of the protocols offered for the communication port shall be an international standard protocol IEC 61850. qq) Be supplied along with all suitable Original Customized licensed software & communication cable for local and remote communications, analysis of fault etc rr) The bay unit shall have built-in Breaker Failure feature **<u>Rated Parameters:</u>** **Bus Bar Protection Functions:** 1. Min fault current pick-up: 500 to 6000 A

		(I_{kmin}) In steps of 100 A 2. Neutral current Detection: 100 to 6000 A 3. Stabilizing factor (K): 0.7 to 0.9 in steps of 0.05 4. Diff current Alarm: 5 to 50% of I_{kmin} 2 to 10 s Time Delay 5. Isolator alarm time delay: 0.5 to 90 s 6. Typical tripping time: 20 to 30 ms 7. CT ratio per feeder: 50 to 10000/1 A **Analog Inputs (Bay or Peripheral or Field Unit):** 1. No. of Bays: Bays at respective s/s + 2 2. Current Rating: 1A, 50 Hz ±2.5 Hz, ≤0.2 VA 3. Thermal Ratings: • Continuous 4xIn • For 10 s Minimum 10xIn • For 1 s 100xIn 5. Voltage Rating: 110 V, 50 Hz, ≤ 0.3 VA at Un 6. Auxiliary Supply: 48 to 250 V DC ±15 %, 11 W **Binary Inputs/ Outputs:** 1. Operating Time: 3 ms 2. Max Operating Volt: 24 to 250 V DC 3. Max Cont rating: ≤ 8 A 4. Max make & Carry: ≤ 30 A (0.5 s) 5. Max making power: ≤ 3300 W (at 110 V DC) 6. Binary O/P Reset: Programmable 7. Breaking Current: Heavy Duty N/O Contact: ≤ 0.3 A Signaling Contact: ≤ 0.1 A 8. No. of I/P per bay unit: 20 Opto-couplers 9. No. of I/P for central unit: 12 Opto-couplers 10. Pickup current for I/P: ≥ 10 mA 11. Operating Time for I/P: < 1 s **Auxiliary Supply:** 1. Input Voltage: 220/110 V DC, ± 20 % 2. Load: 10 W (Bay Unit) 100 W (Central Unit) 3. Front plate Signal: green LED 4. Switch: ON/ OFF 5. Redundancy of Power Supply: Optional **Optical Interface:** 1. Number of Cores: 2 fiber cores per bay unit 2. Core/ sheath diameter: 62.5/ 125 µm (multi-mode) 3. Max permissible attenuation: ≤ 5 db 4. Connector: Type FST for 62.5 µm OFC

		Event Recorder: It shall have event recording facility for minimum last 50 Operational/ fault events. **Disturbance Recorder:** 1. Independent setting for pre-fault and post-fault period 2. Format: COMTRADE **Local & Remote communication:** 1. Serial interface for connecting a PC, either directly or via a modem. 2. System interface for connecting to a control system via IEC 61850. 3. System interfaces via IEC 61850 protocol for interbay bus supports. 4. Time synchronization via IRIG-B.
14	**UNDER VOLTAGE RELAYS**	1) Be triple pole type. 2) Be static/ numerical type. 3) Have range from 40 to 80% 4) Have minimum two potential free NC contact. Self reset type.

ANNEXURE-IV
SPECIFICATION FOR SYNCHRONISING TROLLEY:

Trolley type synchronizing cubicle shall comprise as:

One no	Circuit label.
One no	Flush mounted 96mm x 96mm size synchroscope suitable for 110V AC with synchroscope IN/OUT switch EBS (External box for synchroscope)63.5/110AC.
Two nos	AC voltmeter 96mm x 96mm size, 240 degree scale, transducer operated, with dial scale of 0-250kV and 0-450 kV suitable for 110V/ (Square root of 3) V PT/CVT secondary voltage.
Two nos.	Digital frequency meters, suitable for range 45 to 55hz. With a resolution of 0.01 Hz.
One no.	Check synchronizing relay with percentage voltage difference lock out. Phase angle difference +/- 20 degree. Frequency slips with auxiliary relay for guard.
Two nos.	Indicating lamps, one colored one white for synchronizing.
Two nos.	Indicating lamps for check synchronizing relay IN/OUT.
L.S.	Adequate length of flexible PVC to PVC control cable. 12 cores x 1.5mm square x 5 meter length with 12 pin socket with adopter.

However, trolley shall comprise following items.

- Green lamp (Synchronising in limit)
- Bright lamp (synchronising bright)
- Check synchronizing relay.
- Auxiliary relay
- Voltmeter 0 – 250 KV and 0 – 450 kV operated by 63.5 volts.
- Frequency meters 45-50 -55 Hz (digital with two decimals.)
- Synchroscope in/out switch.
- External box for synchroscope 63.5/110V AC
- Voltage reversing VT
- Synchronizing plug suitable for 12 pin BCH make synch. Socket.
- Link to be inserted for frequency check feature.
- Synchronizing socket - 12 pin.
- Synchroscope.

The details of Synchronizing Relay Types and settings.

(The bidder can offer static/numerical check synchronizing relay as an option to the below mentioned relay. The acceptance shall be with the purchaser depending upon the technical suitability.)

Relays	Phase angle Difference settings	Frequency Difference Settings		Frequency Percentage Difference	Voltage settings
		Phase angle	Time setting (sec.)		
SKE-11 Check Syn.	Preset + 0%-5%	20	0.5	0.45	Difference continuously
		20	1.0	0.22	Variable
		20	1.5	0.15	Voltage
		20 20 20	2.0 2.5 3.0	0.11 0.9 0.07	Difference calibrated at 2%, 4%, 6%, 8% and 10% nominal voltage.

SCHEDULE – B

GUARANTEED TECHNICAL PARTICULARS

(TO BE FILLED IN BY THE BIDDER AND FURNISH WITH TECHNICAL BID)

This schedule contains GTP for all the possible Devices/ Components the C&R panel generally have. However, the GTP is to be filled up in this format for the required Devices/ Components for the C&R panels required in this tender only and, in the page of Tender Specification only, to be submitted in duplicate along with the offer. This is intended for speedy comparison of various bidders GTP. The bidder must fill up all the points of GTP for offered item/s. **Instead of indicating "refer drawing, or as per IS/IEC", the particulars / exact value/s must be filled in** against appropriate items in respect of each rating and type of equipment offered in the broad categories listed below along with supporting authentic technical documents.

(In the absence of GTP in the below mentioned format, the purchaser has every right to evaluate the product accordingly and bidder can not raise any objection against any point of the technical scrutiny.)

	Description	Bidder's Comment
A	**CONTROL AND RELAY PANELS**	
i	Make	
ii	Panel Details 1. Type of panel (Simplex/ Duplex) 2. Equipment mounted on which side of the panel (Control and Relay panel) 3. No. of doors and on which side of the panel. (Control and Relay panel) 4. Thickness of sheet steel (a) Front (b) Door Frame (c) Base Frame (d) Side (e) Cubicle roof (f) Door 5. Overall dimensions of each panel (width x Depth x Height) mm	
iii	Details of painting 1. IS `Code of Practice for phosphating iron and steel' in which accordance the sheet steel work is done. 2. Shed no. and IS of colour. 3. Paint thickness	
iv	Largest package by transport (1) Gross weight (2) Overall dimensions	
v	GA drawing no. attached.	
vi	Mounting details	
vii	Other details, if any.	

B	**PANEL WIRING**	
i	Insulation grade and type	
ii	It shall be single core multi strand flexible wire.	
iii	Conductor used (Copper or Aluminum)	
iv	Size of wiring conductor for following. 1) PT Circuits 2) CT Circuits 3) DC supply circuits 4) Other circuits	
v	Colour code of wiring for following. 1) PT Circuits 2) CT Circuits 3) CVT Circuits 4) DC supply circuits 5) Other circuits	
vi	Type of Lugs, Sleeves and Ferrules to be used for panel internal wiring.	
C	**TERMINAL BLOCKS**	
i	Make	
ii	Construction details	
iii	Voltage grade	
iv	Current rating	
v	Type of TB for CT, CVT, PT wiring and other wiring.	
vi	No. of 2.5 sq. mm Cables that can be connected.	
vii	No. of spare terminals.	
D	**EARTHING**	
i	Conductor or material used for earthing	
ii	Size of the earthing conductor	
iii	Colour and size of the wire used for earthing of different devices in the panel to the earthing bar.	
E	**CIRCUIT LABLE**	
i	Material size and color.	
F	**CONTROL SWITCHES FOR ISOLATORS AND CIRCUIT BREAKERS:**	
i	Make	
ii	Type of switch 1) Stay put/spring Return type 2) Control discrepancy type	
iii	Rating of contacts 1) Voltage 2) Make and carry continuously. 3) Make and carry for 0.5 sec. 4) Break resistive load with L/R ratio of 40 ms.	
iv	Whether locking arrangement provided.	
v	Type of handle standard	

vi	Dimensions	
vii	Mounting details and drawing no.	
viii	Detailed technical literature furnished.	
ix	Other information, if any.	
G	**SEMAPHORE INDICATORS**	
i	Make	
ii	Type	
iii	Diameter of the disc.	
iv	Operating voltage	
v	Burden	
vi	Whether latch in Mechanism provided.	
H	**PUSH BUTTONS**	
i	Make	
ii	Type	
iii	Contact type(momentary/maintained)	
iv	Whether shrouding provided to prevent inadvertent operation.	
v	Whether integral engraved integral plates provided.	
vi	No. of NO/NC contacts.	
I	**INDICATING LAMPS LED**	
i	Make	
ii	Type	
iii	Size of lamps	
iv	Colour of lamps	
v	Life of LED in burning hours.	
vi	Dimensions and mounting details.	
vii	Other information, if any.	
J	**ANNUNCIATORS**	
i	Make	
ii	Type	
iii	Whether conforms to following. 1. It shall be Microprocessor based. 2. Window shall be replaceable. 3. NO/NC selectable 4. Sequence/ grouping selectable 5. Choice of colors 6. Choice of windows sizes 7. Availability of serial part (RS232 to RS 485) output for computer connection 8. It shall have repeat relay card 9. AC/DC fail facility and LED facia 10. Windows based PC software 11. Cables, converters etc. shall also be provided	
iv	No. of points.	

v	Dimensions of each Windows (L X W X H)	
vi	Auxiliary supply voltage 1. For DC fail annunciation (AC Volt) 2. For other than DC fail annunciation (DC Volt) 3. Permissible voltage variation for both supply + / - %	
vii	Minimum duration of impulse for initiating contacts not more than 10milisec.	
viii	Provision of testing facilities for flasher and audible alarm circuit	
ix	Scheme diagrams	
x	Detailed literature attached.	
xi	Other details, if any.	
K	**<u>INSTRUMENTS AND METERS:</u>** Ammeters, voltmeters, MW meters, MVAR meters, Frequency meters, Synchroscope.	
i	Maker's Name	
ii	Type and Model of Instruments	
iii	Size	
iv	Whether magnetically Shielded	
v	Limits of Errors in The effective range	
vi	Maximum scale length	
vii	Total deflection angle	
viii	Class of Accuracy	
ix	Whether tropicalised	
x	Auxiliary Supply	
xi	Short Time overload	
xii	VA burden i) Current coil ii) Potential coil	
xiii	Power consumption i) Current coil ii) Potential coil	
xiv	Continuous over load rating of Current coil.	
xv	Continuous over load rating of Potential coil.	
xvi	Shorting over voltage rating of Potential coil.	
xvii	Shorting over voltage rating of Current coil.	
xviii	Suitably for measurement from transducers on unbalanced 3 phase 4 wire system	
xix	Temperature at which calibrated degree centigrade.	
xx	Range of temp. for Correct operations.	
xxi	Accuracy at 125%, 25% and 10% of rated i) Active energy measured ii) Reactive energy measured	
xxii	Other details, if any.	

xxiii	Type of mounting.	
xxix	Ref. no. of descriptive leaflet, submitted.	
L	**SELECTOR SWITCHES:**	
i	Make	
ii	Type	
iii	Type of handle	
iv	No, of position.	
v	No. of contacts in each position i) Open ii) Close	
vi	Making capacity of contacts	
vii	Breaking capacity of contacts	
viii	Whether locking arrangement provided.	
M	**TRANSDUCERS FOR MW/MVAR**	
i	Make	
ii	Type	
iii	Accuracy Class	
iv	P.T. ratio	
v	C.T ratio	
vi	Input a) Volts b) Amps.	
vii	Output DC mA	
viii	Measuring Range for MW	
ix	Measuring range for MVAR	
x	% AC Ripple on output	
xi	Load Resistance in Ohm	
xii	Aux Voltage	
xiii	Response Time	
xiv	Working Temp range	
N	**TRANSDUCERS FOR VOLTMETERS**	
i	Make	
ii	Type	
iii	Accuracy Class	
iv	PT/CVT ratio	
v	Input Amps	
vi	Output DC mA	
vii	Measuring range output.	
viii	% AC Ripple on output	
ix	Load Resistance in Ohm	
x	Aux Voltage required	
xi	Response Time	
xii	Working Temp range	

O	**TRANSDUCERS FOR CURRENT MEASUREMENT**	
i	Make	
ii	Type	
iii	Accuracy Class	
iv	CT ratio	
v	Input Volts	
vi	Output DC mA	
vii	Measuring range output	
viii	% AC Ripple on output	
ix	Load Resistance in Ohm	
x	Aux Voltage required	
xi	Response time	
xii	Working temp range	
P	**AUXILIARY RELAYS**	
i	Make	
ii	Type & Designation	
iii	Mounting (Flush/ Semi Flush & on Front/ Rear)	
iv	Nominal voltage and % variation	
v	Contacts (hand reset/self reset)	
vi	No. of pairs of contacts i) Make contacts ii) Break contacts	
vii	Speed operation of relay	
viii	Pick up / drop off ratio	
ix	Burden of relay – VA	
x	(i) Contact rating (ii) Voltage (iii) Making current and duration (iv) Breaking current a) Resistive b) Inductive 0.3 PF c) Inductive L/R 10m sec 40m sec	
xi	Detailed literature furnished.	
xii	Standard	
Q	**CONTACT MULTIPLICATION RELAYS:**	
i	Whenever auxiliary relay is used as contact multiplication purpose, the relay should be latch type.	
ii	Other specification as Auxiliary relay. i) Make ii) Type and designation iii) Nominal voltage and % variation. iv) Contacts, hand reset/self reset. v) No. of pairs of contacts. a) Make contacts b) Break contacts vi) Speed of operation of relay vii) Pick up/drop off ratio viii) Burden of relay – VA	

	ix) i)Contact rating ii)Voltage iii)Make current and duration x) Breaking current a) Resistive b) Inductive 0.3 PF c) Inductive L/R 10m sec. 40m sec.	
iii	Detailed literature furnished.	
iv	Standard	
R	**<u>TRIP CIRCUIT SUPERVISION RELAYS</u>**	
i	Make	
ii	Type designation	
iii	Rating	
iv	i) Operating principal ii) Literature write-up enclosed.	
v	Minimum voltage for satisfactory operation.	
vi	Burden	
vii	Monitoring of breaker trip coil in both open and close position provided.	
viii	Safety resistor provided to limit the current if the relay coil is short circuited.	
ix	Output contacts i) No. of NO/NC contacts ii) Rating of contacts	
x	Time delay on drop off	
xi	Type of indication	
xii	Standard	
xiii	Any other relevant details.	
S	**<u>TRIPPING RELAYS</u>**	
i	Make	
ii	Type designation	
iii	Rating	
iv	i) Operating principal ii) Literature write up enclosed	
v	Operating time at rated voltage.	
vi	Relay suitable for being continuously monitored.	
vii	Hand reset/self reset contacts i) No. of NO & NC contacts ii) Rating of contacts.	
T	**<u>TIMERS</u>**	
i	Make	
ii	Type designation	
iii	Nominal voltage and % variation allowed – V	
iv	Range of time delay i) On energization ii) On de-energisation	
v	Accuracy class	

vi	Resetting time	
vii	No. of pairs of contacts i) Make contacts ii) Break contacts	
viii	Contact rating a. Continuous current – Amp. b. Voltage – V c. Making current and duration-Amp. AC/DC d. Breaking current – Amp. e. Resistive f. Inductive g. 0.3 PF A-AC h. Inductive L/R i. 10m sec j. A-DC k. 40m sec – A DC	
ix	Detailed literature furnished.	
x	Standard	
U	**DIRECTIONAL OVERCURRENT AND EARTH FAULT RELAY**	
i	Make	
ii	Type / **Designation**	
iii	Whether comply to Principle Technical Parameters as per Annexure III, Section-II	
iv	Whether Numerical and have true RMS measurement.	
v	Display type for HMI	
vi	Give the details of self monitoring (Hardware & Software) and indication/ alarm facility on internal relay failure	
vii	• Current Input (CT Secondary) • Whether selectable from front panel at site	
viii	Auxiliary Supply and its burden with permissible tolerance.	
ix	No. of poles	
x	**Over Current Protection** **(i) Range in %** **(ii) Steps in %**	
xi	**Earth Fault Protection** **(i) Range in %** **(ii) Steps in %**	
xii	• Type of Characteristics available • Whether selectable from front panel at site	
xiii	• MTA setting for Phase fault • Whether site adjustable	
xiv	• MTA setting for Earth Fault • Whether site adjustable	
xv	Criterion for decision of directionality	
xvi	**High Set O/C Protection** **(i) Range in %**	

xvii	**High Set E/F Protection** **(i) Range in %**	
xviii	**Time multiplier for inverse characteristics** **(i) Range** **(ii) Steps**	
xix	Reset Ratio	
xx	**Built-in Breaker Failure Protection** 1. Current Setting range 2. Timer range 3. No. of poles 4. Operating time 5. Resetting time 6. No. of O/P Contacts available for this feature.	
xxi	**Current Input (CT Secondary) with thermal rating and burden** **(i) For 1A** **(ii) For 5A**	
xxii	• No. of fault event can be stored • Type of data stored on fault	
xxiii	Maximum duration for DR on each fault	
xxvi	No. of Binary Inputs	
xxvii	No. of outputs. (Trip/ Signaling)	
xxviii	Contact rating i) Make and carry continuously ii) Make and carry for 0.5 sec. iii) Break resistive load and inductive load with 40m sec. time constant iv) Whether self reset or hand reset	
xxix	Communication a. Type of port (Front) b. Type of port (Rear) c. Comm. Protocol d. Time sync port	
xxx	Ref. no. of descriptive leaflet enclosed	
xxxi	Temp. rise over ambient temperature	
xxxii	One minute power frequency withstand volt.	
xxxiii	Degree of Protection	
xxxiv	Mounting and dimensional details.	
xxxv	Overall dimensions	
xxxvi	Weight	
xxxvii	**Temperature and humidity** (e) Ambient temp (f) Relative humidity Non Condensing (g) Operate range (h) Storage temp.	
xxxviii	Any other information	
xxxix	**Housing** **(i) Type**	
xxxl	**SCADA compatibility, if available**	

xxxli	**Software** **(i) Name & designation** **(ii) Validity** **(iii) No. of copies** **(iv) Language (English)**	
V	**NON-DIRECTIONAL OVERCURRENT AND EARTH FAULT RELAY**	
i	Make	
ii	Type / **Designation**	
iii	Whether comply to Principle Technical Parameters as per Annexure III, Section-II	
iv	Whether Numerical and have true RMS measurement.	
v	Display type for HMI	
vi	Give the details of self monitoring (Hardware & Software) and indication/ alarm facility on internal relay failure	
vii	• Current Input (CT Secondary) • Whether selectable from front panel at site	
viii	Auxiliary Supply and its burden with permissible tolerance.	
ix	No. of poles	
x	**Over Current Protection** **(i) Range in %** **(ii) Steps in %**	
xi	**Earth Fault Protection** **(i) Range in %** **(ii) Steps in %**	
xii	• Type of Characteristics available • Whether selectable from front panel at site	
xiii	**High set O/C Protection** **(i) Range in %**	
xiv	**High set E/F Protection** **(i) Range in %**	
xv	**Time multiplier for inverse characteristics** **(i) Range** **(ii) Steps**	
xvi	Reset Ratio	
xvii	**Built-in Breaker Failure Protection** 7. Current Setting range 8. Timer range 9. No. of poles 10. Operating time 11. Resetting time 12. No. of O/P Contacts available for this feature.	
xviii	**Time multiplier for inverse characteristics** **(i) Range** **(ii) Steps**	
xix	• No. of fault event can be stored	

	• Type of data stored on fault	
xx	Maximum duration for DR on each fault	
xxi	No. of Binary Inputs	
xxii	No. of outputs. (Trip/ Signaling)	
xxiii	Contact rating v) Make and carry continuously vi) Make and carry for 0.5 sec. vii) Break resistive load and inductive load with 40m sec. time constant viii) Whether self reset or hand reset	
xxvi	Communication a. Type of port (Front) b. Type of port (Rear) c. Comm. Protocol d. Time sync port	
xxvii	Ref. no. of descriptive leaflet enclosed	
xxviii	Temp. rise over ambient temperature	
xxix	One minute power frequency withstand volt.	
xxx	Degree of Protection	
xxxi	Mounting and dimensional details.	
xxxii	Overall dimensions	
xxxiii	Weight	
xxxiv	**Temperature and humidity** (i) Ambient temp (j) Relative humidity Non Condensing (k) Operate range (l) Storage temp.	
xxxv	Any other information	
xxxvi	**Housing** **(i) Type**	
xxxvii	**SCADA compatibility, if available**	
xxxviii	**Software** **(i) Name & designation** **(ii) Validity** **(iii) No. of copies** **(iv) Language (English)**	
W	**<u>DISTANCE RELAYS</u>**	
i	Make	
ii	Type designation	
iii	Whether comply to Principle Technical Parameters as per Annexure III, Section-II	
iv	Whether Numerical measurement.	
v	Auxiliary DC Voltage with permissible tolerance.	
vi	CT input, specify whether selectable at site. Permissible over load.	
vii	PT input with permissible over load.	
viii	Type and no. of measuring elements.	
ix	No. of zones.	

x	Type and no. of starting units.	
xi	Minimum operating current for each element.	
xii	Max. Reactive reach range First zone element Second zone element Third zone element Fourth (Reverse) zone element Power Swing Load Encroachment	
xiii	Max. Resistive reach range First zone element Second zone element Third zone element Fourth (Reverse) zone element Power Swing Load Encroachment	
xiv	Minimum and maximum line length in Km for which the fault can be detected.	
xv	Reset ratio for Distance Protection function	
xvi	Reset ratio for SOTF	
xvii	Type of power swing blocking (state type and characteristic)	
xviii	Operating time range First zone Second zone Third zone Fourth (Reverse) zone element PS Blocking timer PS Deblocking timer	
xix	Relay characteristics angle range for Measuring units Starting units Power swing blocking relays	
xx	Whether suitable for any communication scheme.	
xxi	Have all carrier auxiliary relays been provided (give technical particulars)	
xxii	No. of Binary Inputs and their ratings.	
xxiii	No. of Binary outputs and their ratings.	
xxvi	Tripping time carrier (maximum and minimum)	
xxvii	Type of auto re-close scheme and time range for i) Dead time ii) Reclaim time	
xxviii	**VA burden of each phase relay.** **i) Current circuit** **For 1A & 5A** **ii) Potential circuit**	

	iii) DC circuits	
xxix	Whether continuous self monitoring and diagnostic feature is available.	
xxx	Relay characteristics available	
xxxi	Change in characteristics possible	
xxxii	Burden on CT and VT per phase.	
xxxiii	i) No. of tripping relays provided ii) No. of NO/NC contacts of each tripping relays suitable for use in auto reclosure scheme.	
xxxiv	All aux. relays for the scheme provided.	
xxxv	All external resistors as required provided.	
xxxvi	Carrier ON/OFF provided.	
xxxvii	Auto re-closure scheme with check relay as per specification in annexure III	
xxxviii	Measurements of functions list here.	
xxxix	No. of Disturbance Records and their different time periods.	
xl	Manual online testing facility provided through test plug without isolation of any circuit from panel TB.	
xli	Communication Protocols	
xlii	Time Synchronization	
xliii	Is the scheme exactly as per specification?	
xliv	If not, list out deviations.	
xlv	**Housing** **(i) Type**	
xlvi	**SCADA compatibility, if available**	
xlvii	**Software** **(i) Name & designation** **(ii) Validity** **(iii) No. of copies** **(iv) Language (English)**	
X	**Line Differential Protection Relay**	
i	The relay shall have all the features as per Distance protection relay	
ii	It shall be working on phase segregated current Differential protection principle	
iii	It shall have multiple slope characteristic (preferably) to have stability against CT saturation and heavy through faults as well as sensitivity for internal faults	
iv	It shall measure Differential as well as restrain current continuously and shall display the same as measurement	
v	It shall use fiber optic cable or multiplexed digital network to exchange telegrams.	
vi	It shall communicate to remote end through IEEE C37.94 format	

vii	It shall have redundant communication channels for protection communication	
viii	It shall communicate analogue as well as digital signals to remote end.	
ix	It shall have various communication options for remote communication i.e. mono-mode / multi-mode for direct communication / communication through multiplexer.	
x	It shall have Line charging current compensation feature for better sensitivity	
xi	Distance protection function can be utilized as independent or as back up of Differential protection in case of failure of remote communication	
xii	It shall communicate time coordinated current signals for remote communication to execute Line differential protection algorithm accurately. Time synchronization through GPS shall also be possible	
xiii	It shall monitor individual communication links continuously and switchover to standby link after preset time in case of failure of one link	
xiv	It shall supervise individual telegrams	
xv	It shall detect reflected telegrams	
xvi	It shall detect change in communication delay time	
xvii	It shall measure delay time for remote end along with dynamic compensation of the same in differential protection algorithm	
xviii	It shall also supervise maximum permissible delay time	
xix	It shall generate alarm for heavily disturbed communication link	
	Differential Protection setting	
xx	Minimum operating current	
xxi	Slope (Single/dual)	
xxii	End section (Single/dual)	
xxiii	Highset operating current	
xxiv	2 nd Harmonic blocking	
xxv	Typical operating time	
xxvi	Operating time for high set	
xxvii	Charging current compensation	
	Remote Communication	
xxviii	Nos. of Analogue signal transfer	
xxix	Nos. of Binary signal transfer	
xxx	Dual Remote Communication module a. 1300 nm - multi-mode OR b. 1300 / 1550 nm – mono-mode	

xxxi	Synchronization mode - GPS Echo	
xxxii	Time delay alarm for communication fail	
xxxiii	Time delay for switching to redundant channel	
xxxiv	Asymmetric delay (For echo mode)	
xxxv	Max. Transmission delay time	
Y	**BACKUP IMPEDANCE RELAY**	
i	Make	
ii	Type & designation	
iii	Whether comply to Principle Technical Parameters as per Annexure III, Section-II	
iv	Whether Numerical measurement.	
v	Auxiliary DC Voltage with permissible tolerance.	
vi	CT input with Permissible over load.	
vii	PT input with permissible over load.	
viii	Type and no. of measuring elements.	
ix	No. of zones.	
x	Type and no. of starting units.	
xi	Relay characteristics	
xii	Impedance setting range	
xiii	Timer range	
xiv	Relay characteristics angle range for Measuring units Starting units	
xv	**Max. VA burden per phase.** **Current circuit** **(i) For 1A** **(ii) For 5A** **Potential circuit** **DC circuits**	
xvi	Whether continuous self monitoring and diagnostic feature is available.	
xvii	Is the scheme exactly as per specification?	
xviii	**Housing** **(i) Type**	
xix	**SCADA compatibility, if available**	
xx	**Software** **(i) Name & designation** **(ii) Validity** **(iii) No. of copies** **(iv) Language (English)**	
Z	**FUSE FAILURE RELAY**	
i	Make	
ii	Type designation	

iii	Whether comply to Principle Technical Parameters as per Annexure III, Section-II	
iv	i) Rating V AC	
v	i) Operating principle ii) Literature write up enclosed	
vi	Operating time	
vii	Burden	
viii	Output contacts i) No. of NO and NC contacts ii) Rating of contacts	
ix	i) Additional fuses required at line VT ii) Arc fuses provided	
AA	**DC SUPERVISION RELAY**	
i	Make	
ii	Type designation	
iii	Whether comply to Principle Technical Parameters as per Annexure III, Section-II	
iv	General design	
v	DC rating (voltage)	
vi	Output contacts	
vii	Any other data	
AB	**DIFFERENTIAL RELAYS**	
i	Make	
ii	Type and designation	
iii	Whether comply to Principle Technical Parameters as per Annexure III, Section-II	
iv	Whether Numerical measurement.	
v	Whether continuous self monitoring and diagnostic feature is available	
vi	Current circuit rating	
vii	Operating principle	
viii	Number of poles	
ix	**Max. V.A burden** **For 1A** **i) Operating circuit** **ii) Restraining circuit** **For 5A** **i) Operating circuit** **ii) Restraining circuit**	
x	Min. Operating current	
xi	Is the slope setting variable.	
xii	Setting ranges available	
xiii	Power consumption i) Operating circuit ii) Restraining circuit	
xiv	2nd and 5th harmonic restrain provided or not.	
xv	Whether internal angle and ratio correction is available.	

xvi	Operating time i) at 2 x In ii) At 10 x In iii) Time take to energize the trip coil of the break for initiation of fault current as in (I and II) above.	
xvii	Resetting ratio	
xviii	Adjustable bias setting.	
xix	Three pole instantaneous high set units provided.	
xx	Burden on purchaser's CT	
xxi	Output contacts and their ratings.	
xxii	Shall have the following functions. i. Differential Protection ii. Restricted Earth Fault Protection iii. Thermal Over Load Detection iv. Over Fluxing Protection v. LBB	
xxiii	Details of Disturbance Recording facility.	
xxvi	Descriptive leaflet Ref. No.(to be enclosed)	
xxvii	**Communication protocol**	
xxviii	**Local Computer communication port** **(i) Front** **(ii) Rear**	
xxix	**Housing** **(i) Type**	
xxx	**SCADA compatibility, if available**	
xxi	**Software** **(i) Name & designation** **(ii) Validity** **(iii) No. of copies** **(iv) Language (English)**	
AC	**OVER FLUXING RELAYS**	
i	Make	
ii	Type designation	
iii	Whether comply to Principle Technical Parameters as per Annexure III, Section-II	
iv	Static or Numerical	
v	Rating (V/Hz)	
vi	Operating principal	
vii	Setting range	
viii	No. of stages in relay	
ix	No. of timers provided and range of time settings available.	
x	Burden	
xi	Auxiliary relays as necessary to make scheme complete provided.	
xii	No. and rating of protective and auxiliary relay contacts.	
xiii	Write up on the relay enclosed.	

AD	**AUXILIARY CTS AND VTS**	
xviii	Make	
xix	Type	
xx	Whether comply to Principle Technical Parameters as per Annexure III, Section-II	
xxi	Quantity	
xxii	Ratio	
xxiii	Rated output VA	
xxvi	Standard to which confirms	
xxvii	Class of accuracy short time current.	
xxviii	Short time current voltage rating.	
xxix	Knee point voltage for class PS only.	
AE	**RESTRICTED EARTH FAULT RELAYS:**	
i	Make	
ii	Type	
iii	Whether comply to Principle Technical Parameters as per Annexure III, Section-II	
iv	Maximum VA burden	
v	Operating time i) Minimum ii) Maximum	
vi	Description leaflet Ref. no.	
vii	No. of contacts make and carry for 0.5 sec and break type.	
viii	Whether contacts self reset or hand reset.	
ix	Contact ratings i) Make and carry continuously ii) Make and carry for 0.5 sec. iii) Break resistive load and inductive load with 40 m. sec. time current.	
x	Setting range.	
AF	**BUS DIFFERENTIAL RELAY**	
i	Make	
ii	Type designation	
iii	Whether comply to Principle Technical Parameters as per Annexure III, Section-II	
iv	**Bus Bar Protection Functions:** 1. Min fault current pick-up range (I_{kmin}) 2. Neutral current Detection range 3. Stabilizing factor (K) 4. Diff current Alarm setting range 5. Time Delay for (4) above 6. Isolator alarm time delay setting 7. Typical tripping time	
v	**Check Zone:** 1. Min fault current pick-up range (I_{kmin}) 2. Stabilizing factor (K)	
vi	**Analog Inputs (Bay or Peripheral or Field Unit):**	

	1. Maximum no. of Bays which can be connected with central unit 2. Current Rating 3. Thermal Ratings: Continuous For 10 s, Minimum 10xIn For 1 s, 100xIn 4. Voltage Rating 5. Auxiliary Supply	
vii	**Binary Inputs/ Outputs:** 1. Operating Time 2. Max Operating Volt 3. Max Cont rating 4. Max make & Carry 5. Max making power 6. Whether Binary O/P Reset Programmable 7. Breaking Current: Heavy Duty N/O Contact: Signaling Contact: 8. No. of I/P per bay unit 9. No. of I/P for central unit 10. Pickup current for I/P 11. Operating Time for I/P	
viii	**Auxiliary Supply:** 1. Input Voltage: 2. Load: (Bay Unit) (Central Unit) 3. Front plate Signal 4. Switch 5. Redundant power Supply: Optional	
ix	**Optical Interface:** 1. Number of Cores 2. Core/ sheath diameter 3. Max permissible attenuation 4. Connector:	
x	**Event Recorder:** It shall have event recording facility for minimum last 50 Operational/ fault events.	
xi	**Disturbance Recorder:** 1. Independent setting for pre-fault and post-fault period 2. Format	
xii	**Local & Remote communication:** 1. Serial interface for connecting a PC, either directly or via a modem. 2. System interface for connecting to a control system via IEC 61850. 3. System interfaces via IEC 61850 protocol for interbay bus supports. 4. Time synchronization via IRIG-B.	

xiii	Maximum fault current for which 100% stability can be achieved.	
xiv	Impedance type and operating characteristic	
xv	Continuous supervision of CT secondary against open circuit	
xvi	Architecture & Interconnection of Central unit and bay unit panel.	
xvii	Principle of CT ratio error matching	
xviii	Measuring and tripping criterion	
xix	HMI details	
xx	Self supervision and diagnostic facility.	
xxi	Measurements available	
xxii	Whether bus bar image for each bay is formed and displayed in HMI	
xxiii	Redundant hardware available	
xxvi	Standard functions available	
xxvii	Optional functions available	
xxviii	Reset through a single push button	
xxix	Future configuration and activation of new bays should be possible	
xxx	Any deviations	
xxxi	Any other details	
AG	**GENERAL**	
i	Whether agreed for Testing & Commissioning of the panels at site.	
ii	Whether agreed for 24 Months Performance Guarantee.	
iii	Whether agreed for Demonstration of the offered panel or any loose item to be used in the panel, if asked before the opening of the price bid.	
iv	Whether agreed for Training if asked by the purchaser.	
v	Whether Schedule B and G dully sealed and signed attached.	
vi	TOOLS Whether Optional tools required for testing/ commissioning/ maintenance is listed and price for the same is given	
vii	SPARES: Whether list of recommended spares for normal maintenance for period of 5 years furnished.	

However, bidder shall minimum cover all the specifications mentioned in Annexure-III, even if it is not listed in the above table.

DATE & SEAL OF THE COMPANY

NAME OF THE FIRM
SIGNATURE OF THE BIDDER - DESIGNATION

SCHEDULE: G
LIST OF EQUIPMENT FOR CONTROL AND RELAY PANELS
(TO BE FILLED IN BY THE BIDDER)

Sr.no.	Description	Qty. reqd.	Make and type designation

ANNEXURE-V
TYPICAL BINARY INPUT- OUTPUT LIST

SR. No.	Item	Binary Input and Output List	
1.	DISTANCE PROTECTION - Main-1	**Binary Inputs to Distance Protection - Main-1**	
		Sr. No.	Input Description
		1	Breaker R - Ph pole OPEN (own + TBC)
		2	Breaker Y - Ph pole OPEN (own + TBC)
		3	Breaker B - Ph pole OPEN (own + TBC)
		4	CB Ready (Spring charged) (own + TBC)
		5	CB Lockout (own + TBC)
		6	CB TNC switch 'Close' contact for SOTF (own + TBC)
		7	Auto Reclose IN
		8	86 Operated (Both A & B) (own+TBC)
		9	LBB Trip Relay Operated (own + TBC)
		10	Bus Bar Protection Operated (own + TBC)
		11	Main - 2 Operated
		12	Carrier - 1 Healthy
		13	Carrier - 2 Healthy
		14	Carrier Receive
		15	Direct Trip -1 Receive
		16	Direct Trip -1 Send
		17	Trip Coil -1 Faulty
		18	DC source - 2 Fail
		19	LBB Initiation - R - Ph (from Main-2)
		20	LBB Initiation - Y - Ph (from Main-2)
		21	LBB Initiation - B - Ph (from Main-2)
		22	HMI Block (for settings)
		23	NIT switch in ' I ' position
		24	NIT switch in ' T ' position

		Outputs From Distance Protection - Main-1	
		Sr. No.	Output Description
		1	Trip coil - 1 - R Ph
		2	Trip coil - 1 - Y Ph
		3	Trip coil - 1 - B Ph
		4	Trip coil - 2 - R Ph or CMR (TBC TC1&2, TBC A/R)
		5	Trip coil - 2 - Y Ph or CMR (TBC TC1&2, TBC A/R)
		6	Trip coil - 2 - B Ph or CMR (TBC TC1&2, TBC A/R)
		7	86 - A Relay
		8	Bus Bar OR M2 LBB initiation - R Ph
		9	Bus Bar OR M2 LBB initiation - Y Ph
		10	Bus Bar OR M2 LBB initiation - B Ph
		11	Carrier Send
		12	Breaker Close command for A/R
		13	Main - 2 for DR
		14	Direct trip send relay-1
		15	Direct trip send relay-2
		16	Main -1 Relay Inoperative
		17	Main -1 Operated Annunciation
		18	O/V stage -1/2 Operated Annunciation
		19	LBB Operated Annunciation
		20	Main -1 Carrier Send Annunciation
		21	Main -1 Carrier Receive Annunciation
		22	Carrier -1 Fail Annunciation
		23	Main -1 A/R operated
		24	Main -1 A/R Lock Out
		25	SOTF Operated
		26	Power swing Blocking Operated Annunciation
		27	Power swing Trip Operated Annunciation
		28	VT Fuse Fail Annunciation
		29	Broken Conductor Annunciation
		30	Sense Contact for test Kit
		31	LBB Trip relay to Own+TBC (In IT Mode)
		32	A/R lockout to TBC

2.	**DISTANCE PROTECTION – Main-2**	**Binary Inputs to Distance Protection - Main-2**	
		Sr. No.	Input Description
		1	Breaker R - Ph pole OPEN (own + TBC)
		2	Breaker Y - Ph pole OPEN (own + TBC)
		3	Breaker B - Ph pole OPEN (own + TBC)
		4	CB Ready (Spring charged) (own + TBC)
		5	CB Lockout (Main + TBC)
		6	CB TNC switch 'Close' contact for SOTF (own + TBC)
		7	Auto Reclose IN
		8	86 Operated (Both A & B) (own + TBC)
		9	LBB Trip Relay Operated (own + TBC)
		10	Bus Bar Protection Operated (own + TBC)
		11	Main - 1 Operated
		12	Carrier - 1 Healthy
		13	Carrier - 2 Healthy
		14	Carrier Receive
		15	Direct Trip -2 Receive
		16	Direct Trip -2 Send
		17	Trip Coil -2 Faulty
		18	DC source - 1 Fail
		19	LBB Initiation –R - Ph (from Main-1)-(If LBB of M-II Used)
		20	LBB Initiation - Y - Ph (from Main-1)-(If LBB of M-II Used)
		21	LBB Initiation - B - Ph (from Main-1)-(If LBB of M-II Used)
		22	HMI Block (for settings)
		23	NIT switch in ' I ' position
		24	NIT switch in ' T ' position

		Outputs From Distance Protection - Main-2	
		Sr. No.	Output Description
		1	Trip coil - 1 - R Ph
		2	Trip coil - 1 - Y Ph
		3	Trip coil - 1 - B Ph
		4	Trip coil - 2 - R Ph or CMR (TBC TC1&2, TBC A/R)
		5	Trip coil - 2 - Y Ph or CMR (TBC TC1&2, TBC A/R)
		6	Trip coil - 2 - B Ph or CMR (TBC TC1&2, TBC A/R)
		7	86 - B Relay
		8	Bus Bar AND / OR M1 LBB initiation - R Ph or CMR
		9	Bus Bar AND / OR M1 LBB initiation - Y Ph or CMR
		10	Bus Bar AND OR M1 LBB initiation - B Ph or CMR
		11	Carrier Send
		12	Breaker Close command for A/R
		13	Main - 1 for DR
		14	Direct trip send relay-1
		15	Direct trip send relay-2
		16	Main -2 Relay Inoperative
		17	Main -2 Operated Annunciation
		18	O/V stage -1/2 Operated Annunciation
		19	Main -2 Carrier Send Annunciation
		20	Main -2 Carrier Receive Annunciation
		21	Carrier -2 Fail Annunciation
		22	Main -2 A/R operated
		23	Main -2 A/R Lock Out
		24	SOTF Operated
		25	Power swing Blocking Operated Annunciation
		26	Power swing Trip Operated Annunciation
		27	VT Fuse Fail Annunciation
		28	Broken Conductor Annunciation
		29	Sense Contact for test Kit
		30	A/R Lockout to TBC
		31	LBB Protn Optd Annunciation
		32	LBB Trip relay to Own+TBC (In IT Mode)

3.	**% BIASED DIFFERENTIAL PROTECTION**	**Binary Inputs to Transformer Differential Protection Relay**	
		Sr. No.	Input Description
		1	Main / TBC CB R-Phase Open
		2	Main / TBC CB Y-Phase Open
		3	Main / TBC CB B-Phase Open
		4	LV CB Open
		5	Main/TBC CB Lock Out
		6	Buchholz Trip
		7	OSR Trip (RYB Phase)
		8	Trip Ckt.-1 Faulty
		9	PRD 1&2 Trip
		10	Wining Temperature High Trip
		11	Oil Temperature High Trip
		12	Deluge Valve Trip
		13	DC Supply Source-2 Fail
		14	HMI Block (for settings)
		15	Buchholz Alarm
		16	Cooler Control Trouble Alarm
		17	Winding Temperature High Alarm
		18	Oil Temperature High Alarm
		19	Low Oil Level Alarm
		20	Main/TBC 3-Ph Trip Relay Operated
		21	Main/TBC LBB Trip Relay Operated
		Outputs From Transformer Differential Protection Relay	
		Sr. No.	Output Description
		1	LBB Protection Operated
		2	To NIFPS scheme
		3	87 Operated Alarm
		4	Over flux Protection Operated Alarm
		5	LBB Protection Operated Alarm
		6	To Test Kit Reset
		7	Differential Protection Operated (3-Ph Trip)
		8	Over flux Protection Operated (3-Ph Trip)
		9	Over flux Protection Operated Alarm
		10	Differential Protection Operated to 64 Relay
		11	Differential Relay Faulty

4.	**TRAFO. BACKUP RELAY (Dir. O/C & E/F Relay)**	**Binary Inputs to Transformer Backup Relay (Directional O/C & E/F Relay)**	
		Sr. No.	Input Description
		1	HMI Block (for settings)
		2	Differential Protection Operated
		3	REF Protection Operated
		4	Trip Relay Operated. (own + TBC)
		5	Trip Ckt.-2 Faulty
		6	DC Supply Sorce-1 Fail
		7	NIT On Transfer
		8	NIT On Inter
		Outputs From Transformer Backup Relay (Directional O/C & E/F Relay)	
		Sr. No.	Output Description
		1	O/C-E/F Protection Operated to 64 Relay
		2	To Test Kit Reset
		3	To 3-Phase Trip Relay (86B)
		4	LBB Protection Operated to 96 Relay
		5	O/C-E/F Protection Operated Alarm
		6	LBB Protection Operated Alarm
		7	To NIFPS for REF Relay operated
		8	To NIFPS for O/C-E/F Protection Operated
		9	O/C-E/F Relay Faulty
5.	**TRAFO. RESTRICTED EARTH FAULT PROECTION (R.E.F. PROECTION)**	**Binary Inputs to REF Protection Relay**	
		Sr. No.	Input Description
		1	HMI Block (for settings)
		2	Differential Protection Operated
		3	REF Protection Operated
		Outputs From REF Protection Relay	
		Sr. No.	Output Description
		1	REF Protection Operated Alarm
		2	REF Protection Operated to 86B 3-phase trip relay
		3	REF Protection Operated to 67 Relay
		4	For Test Kit Reset
		5	REF Relay Faulty

6.	**BUSCOUPLER (Dir. O/C & E/F Relay)**	**Binary Inputs to Directional O/C & E/F Relay of BUSCOUPLER**	
		Sr. No.	Input Description
		1	CB R-Phase Open
		2	CB Y-Phase Open
		3	CB B-Phase Open
		4	DC Supply Source-2 Fail
		5	CB Lock Out
		6	CB SF6 Gas Pr. Low
		7	Trip Relay Operated
		8	Trip Ckt.-1 Faulty
		9	Trip Ckt.-2 Faulty
		10	LBB Trip Relay (96A/B) Operated
		11	Busbar Protection Operated
		Outputs From Directional O/C & E/F Relay of BUSCOUPLER	
		Sr. No.	Output Description
		1	O/C-E/F Relay Faulty
		2	O/C-E/F Protection Operated
		3	O/C-E/F Protection Operated
		4	LBB Protection Operated
		5	LBB Protection Operated
		6	LBB Protection Operated
		7	Selected Bus PT fail
		8	Kit Reset

ANNEXURE-VI
TYPICAL ANNUNCIATION LIST

SR. No.	Item	ANNUNCIATION LIST	
1.	FEEDER CONTROL & RELAY PANEL	Sr. No.	Description
		1	Main -1 Dist. Prot. Operated
		2	SOTF Protection Operated
		3	Power swing blocked
		4	Autoreclose lockout
		5	Main -2 Dist. Prot. Operated
		6	Autoreclose Operated
		7	LBB Prot. Operated (Main-1 & Busbar)
		8	Direct Trip Received -1/2
		9	Direct Trip sent - 1/2
		10	86A Operated
		11	86B Operated
		12	Broken conductor detection
		13	Power swing trip Operated
		14	Carrier sent - 1/2
		15	Trip Ckt.-1 faulty
		16	Trip Ckt.-2 faulty
		17	SF6 Gas pressure low
		18	Carrier fail - 1/2
		19	Carrier receive - 1/2
		20	Main-1 VT fuse fail
		21	Main-2 VT fuse fail
		22	Over Voltage Protection Operated
		23	Main-1 internal fail
		24	Main-2 internal fail
		25	86A faulty
		26	86B faulty
		27	CB Lockout
		28	Busbar protection Operated
		29	LBB Trip relay Operated
		30	CT Circuit Faulty

		31	Isolator Discrepancy Alarm
		32	Busbar interconnected
		33	DC Supply Source-1 fail
		34	DC Supply Source-2 fail
		35	AC fail
		36	DC fail
2.	**TRANSFORMER CONTROL & RELAY PANEL (HV SIDE)**	Sr. No.	Description
		1	Differential Protection Operated
		2	Over Flux Protection Operated
		3	O/C & E/F Protection Operated
		4	REF Protection Operated
		5	LBB Protection Operated
		6	Pole Discrepancy Operated
		7	GR-A Trip Relay Operated
		8	GR-B Trip Relay Operated
		9	LBB Trip Relay Operated
		10	Differential Relay Faulty
		11	REF Relay Faulty
		12	O/C & E/F Relay Faulty
		13	GR-A Trip Relay Faulty
		14	GR-B Trip Relay Faulty
		15	Trip Ckt.-1 faulty
		16	Trip Ckt.-2 faulty
		17	Transformer Buchholz Trip
		18	Transformer Buchholz Alarm
		19	Transformer Oil/Winding Temp. High Trip
		20	Transformer Oil/Winding Temp. High Alarm
		21	Transformer Low Oil Level
		22	Transformer PRD 1/2 Trip
		23	Transformer Over flux Alarm
		24	Transformer OLTC OSR Trip
		25	Transformer Cooler Control Trouble
		26	Transformer Deluge Valve Trip
		27	CB Lockout
		28	CB SF6 Gas Pressure Low

		29	Busbar protection Operated
		30	CT Circuit Faulty
		31	Isolator Discrepancy Alarm
		32	Busbar interconnected
		33	DC Supply Source-1 fail
		34	DC Supply Source-2 fail
		35	AC fail
		36	DC fail
3.	**TRANSFORMER CONTROL & RELAY PANEL (LV SIDE)**	Sr. No.	Description
		1	Over Flux Protection Operated
		2	Over Flux Protection Alarm
		3	O/C & E/F Protection Operated
		4	LBB Protection Operated
		5	Pole Discrepancy Operated
		6	GR-A Trip Relay Operated
		7	GR-B Trip Relay Operated
		8	LBB Trip Relay Operated
		9	O/C & E/F Relay Faulty
		10	GR-A Trip Relay Faulty
		11	GR-B Trip Relay Faulty
		12	Trip Ckt.-1 faulty
		13	Trip Ckt.-2 faulty
		14	CB Lockout
		15	CB SF6 Gas Pressure Low
		16	Busbar protection Operated
		17	CT Circuit Faulty
		18	Isolator Discrepancy Alarm
		19	Busbar interconnected
		20	DC Supply Source-1 fail
		21	DC Supply Source-2 fail
		22	AC fail
		23	DC fail

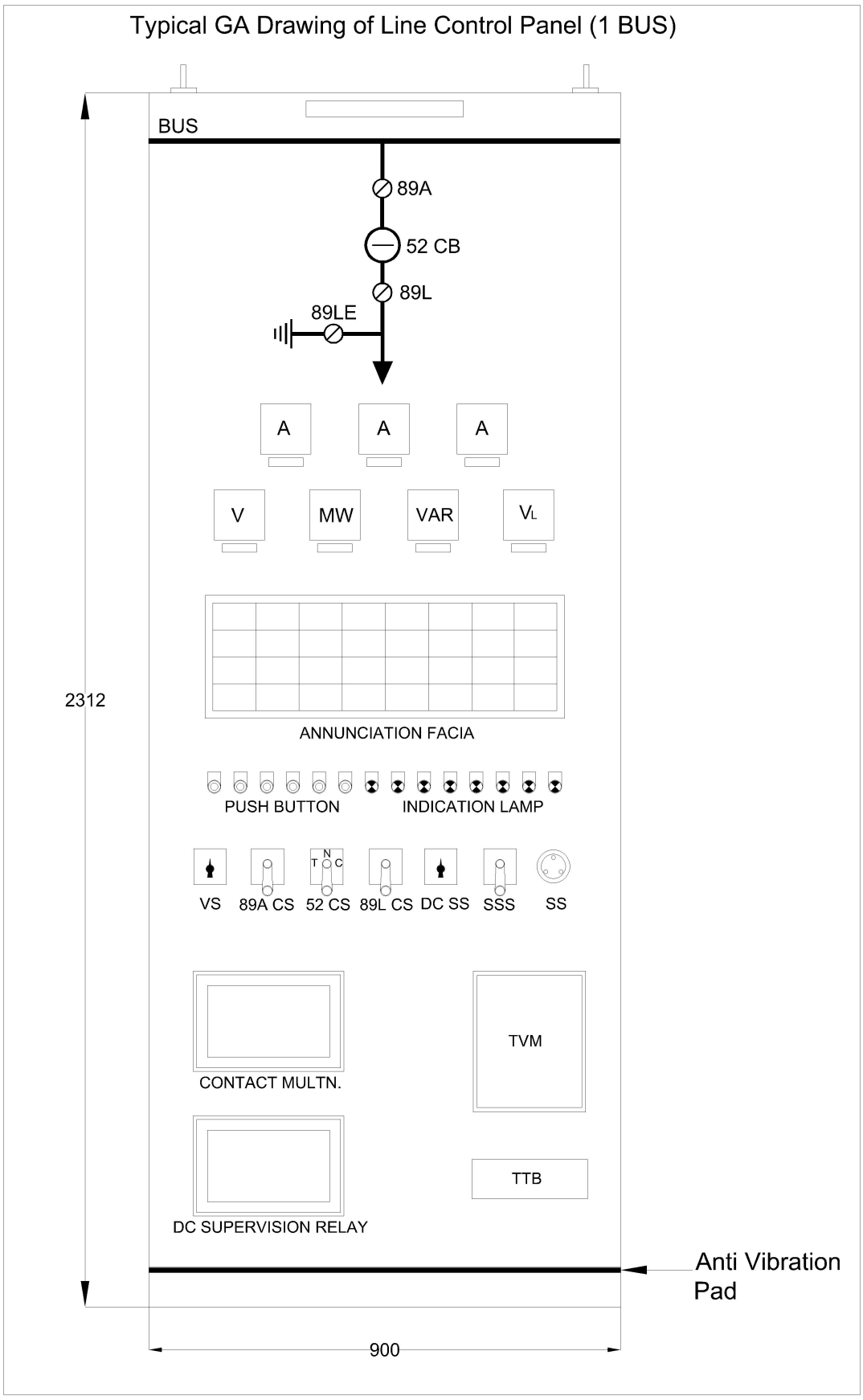
4.	**REACTOR CONTROL & RELAY PANEL**	Sr. No.	Description
		1	Differential Protection Operated
		2	Backup Impedance Protection Operated
		3	REF Protection Operated
		4	LBB Protection Operated
		5	Pole Discrepancy Operated
		6	GR-A Trip Relay Operated
		7	GR-B Trip Relay Operated
		8	LBB Trip Relay Operated
		9	Differential Relay Faulty
		10	REF Relay Faulty
		11	Backup Impedance Relay Faulty
		12	GR-A Trip Relay Faulty
		13	GR-B Trip Relay Faulty
		14	Trip Ckt.-1 faulty
		15	Trip Ckt.-2 faulty
		16	Buchholz Trip
		17	Buchholz Alarm
		18	Oil/Winding Temp High Trip
		19	Oil/Winding Temp. High Alarm
		20	Low Oil Level
		21	PRD 1/2 Trip
		22	Cooler Control Trouble
		23	Deluge Valve Trip
		24	CB Lockout
		25	CB SF6 Gas Pressure Low
		26	Busbar protection Operated
		27	CT Circuit Faulty
		28	Isolator Discrepancy Alarm
		29	Busbar interconnected
		30	DC Supply Source-1 fail
		31	DC Supply Source-2 fail
		32	AC fail
		33	DC fail

5.	**BUSCOUPLER CONTROL & RELAY PANEL**	Sr. No.	Description
		1	O/C-E/F Protection Operated
		2	U/V Relay Operated
		3	LBB Protection Operated
		4	BUS VT Supply fail
		5	Trip Relay Operated
		6	Trip Relay Faulty
		7	O/C-E/F Relay Faulty
		8	Trip Ckt.-1 faulty
		9	Trip Ckt.-2 faulty
		10	LBB Trip Relay Operated
		11	Busbar Protection Operated
		12	Busbar Zone-1 Operated
		13	Busbar Zone-1 CT Circuit Faulty
		14	Busbar Zone-2 Operated
		15	Busbar Zone-2 CT Circuit Faulty
		16	Busbar Zone-3 Operated
		17	Busbar Zone-3 CT Circuit Faulty
		18	Busbar DC Supply Source-1 fail
		19	Busbar DC Supply Source-2 fail
		20	CB SF6 Gas Pressure Low
		21	CB Lockout
		22	Busbar Central Unit Faulty
		23	Check zone Operated
		24	Busbar Protection Bay Unit Faulty
		25	CT Circuit Faulty
		26	Communication Error
		27	Isolator Discrepancy Alarm
		28	DC Supply Source-1 fail
		29	DC Supply Source-2 fail
		30	AC fail
		31	DC fail

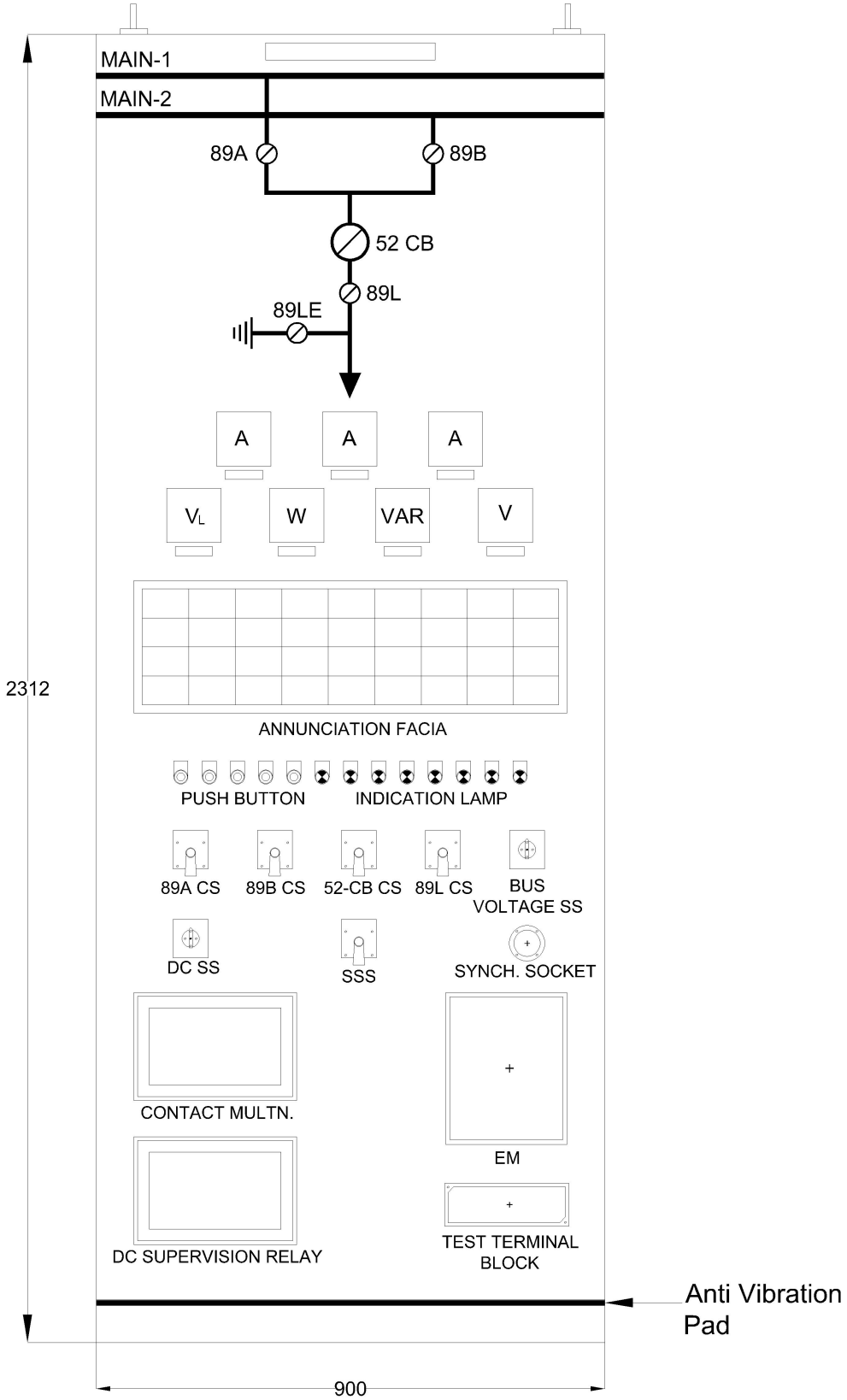
6.	**TRANSFER BUSCOUPLER CONTROL & RELAY PANEL**	Sr. No.	Description
		1	LBB Protection Operated
		2	Autoreclose Lockout
		3	Autoreclose Operated
		4	3-Ph Trip Relay Operated
		5	LBB Trip Relay Operated
		6	Autoreclose Relay Faulty
		7	Trip Relay Faulty
		8	Trip Ckt.-1 faulty
		9	Trip Ckt.-2 faulty
		10	CB Lockout
		11	CB SF6 Gas Pressure Low
		12	Busbar protection Operated
		13	CT Circuit Faulty
		14	Isolator Discrepancy Alarm
		15	Busbar interconnected
		16	DC Supply Source-1 fail
		17	DC Supply Source-2 fail
		18	AC fail
		19	DC fail

ANNEXURE-VII
TYPICAL GENERAL ARRANGEMENT DRAWING

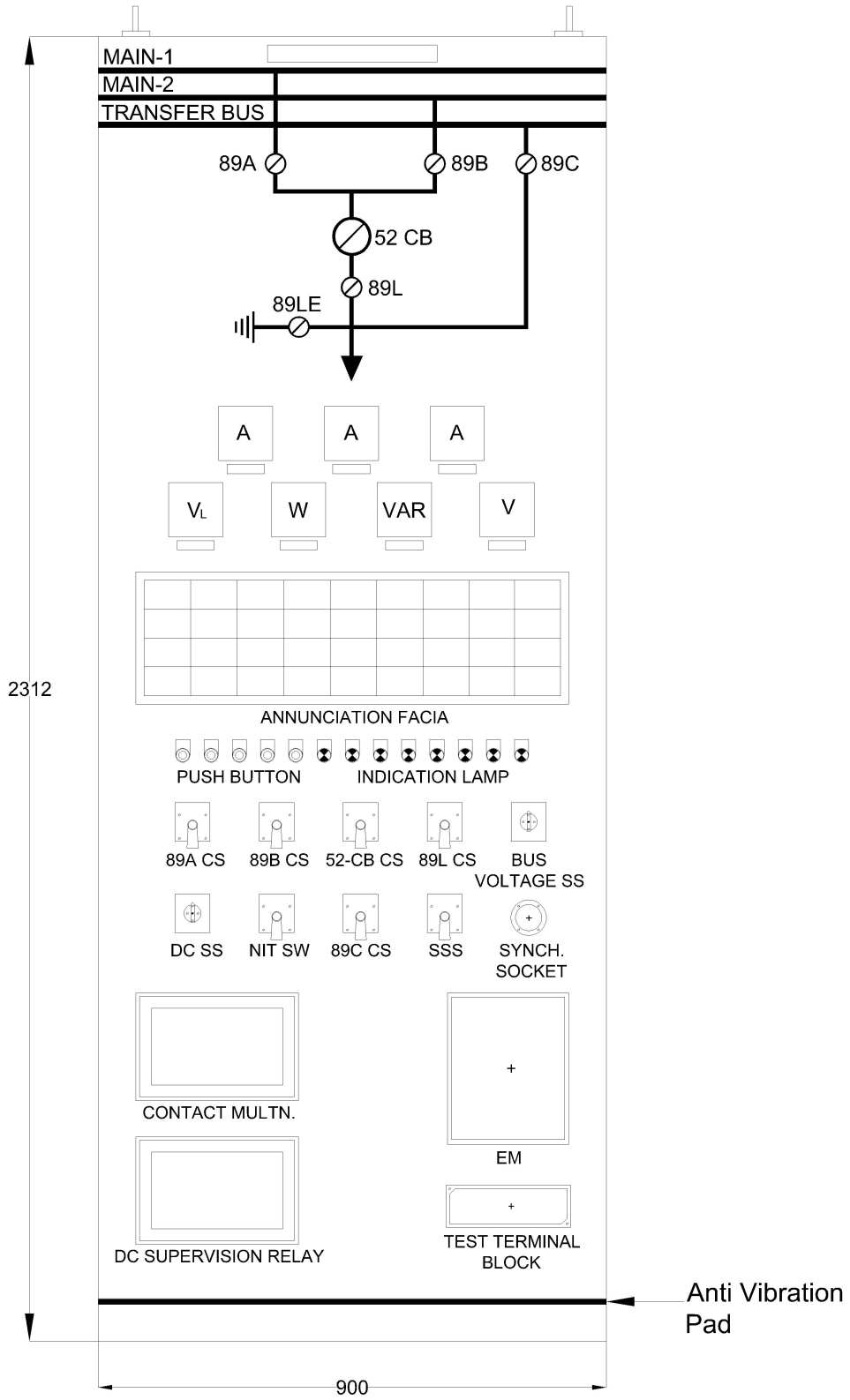
A. FEEDER CONTROL PANEL



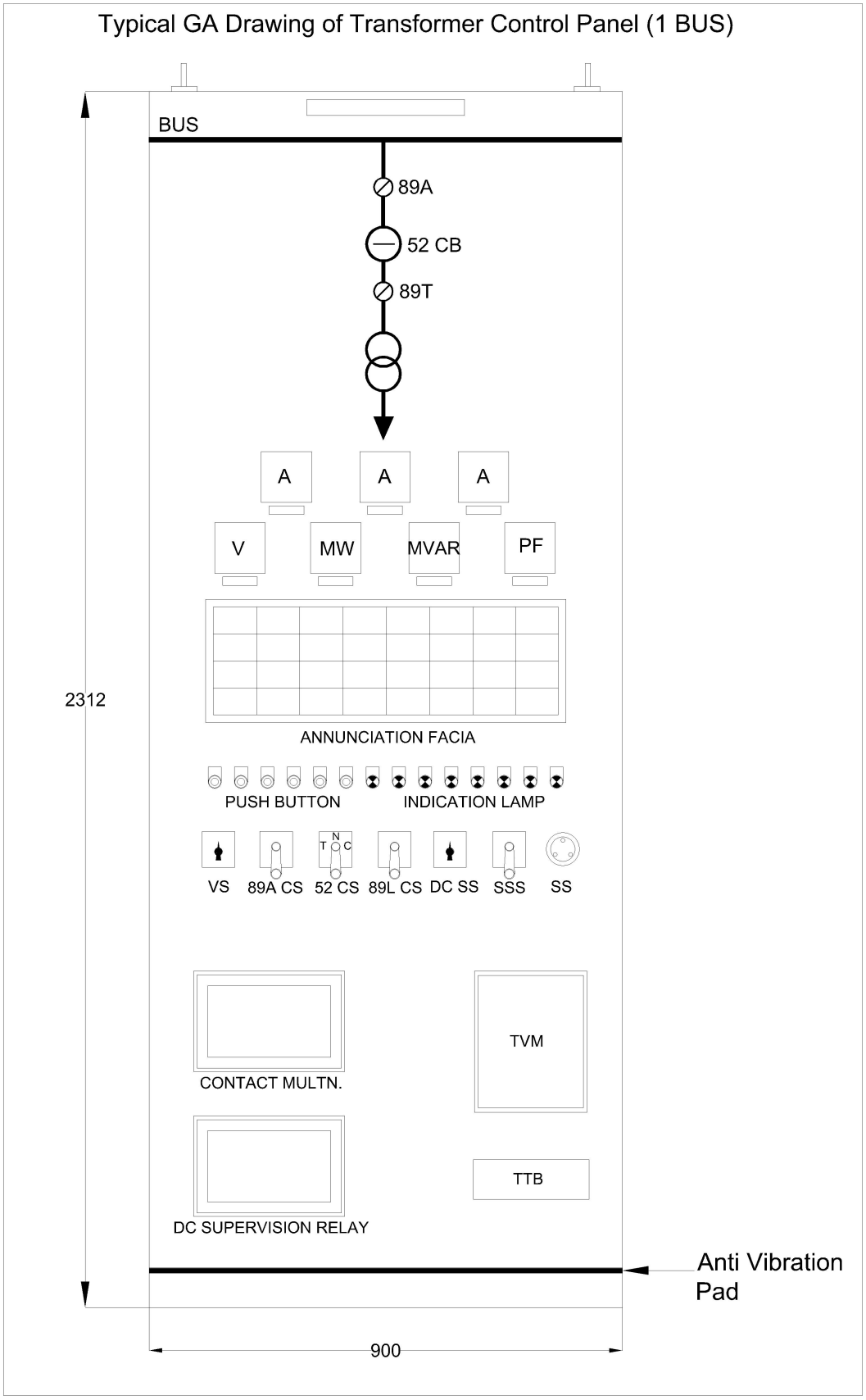
Typical GA Drawing of Line Control Panel (2 BUS)



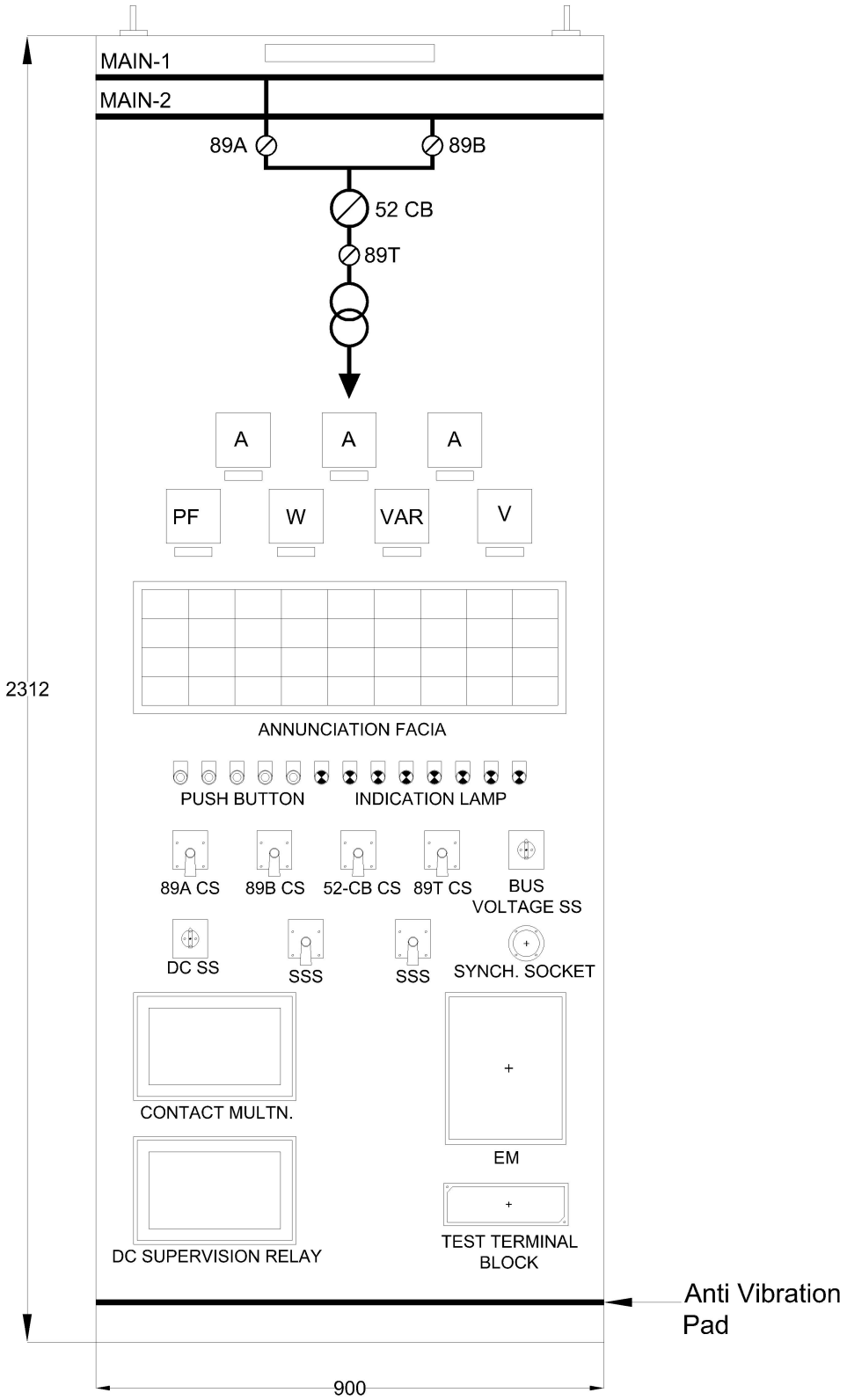
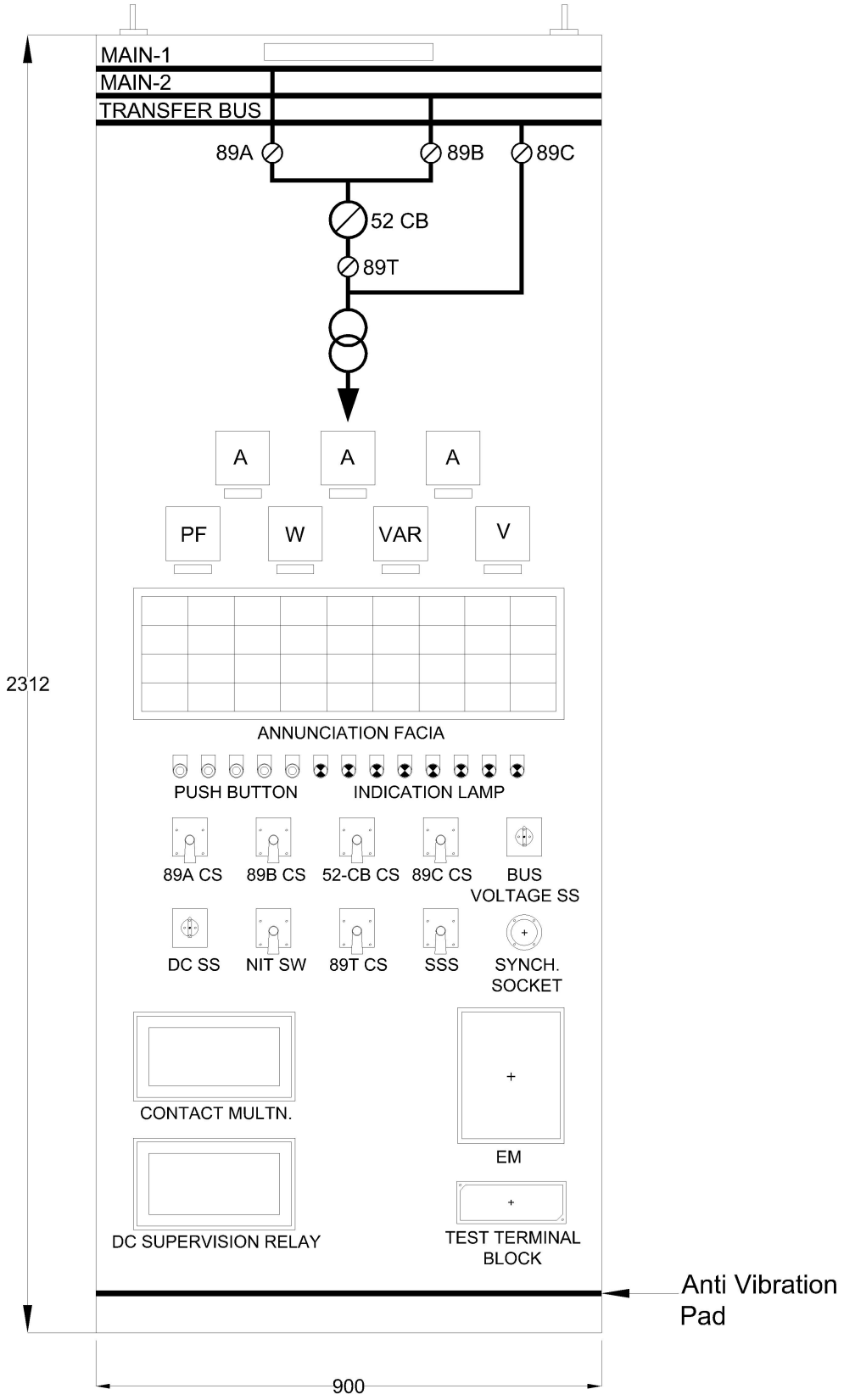
Typical GA Drawing of Line Control Panel (3 BUS)



B. TRANSFORMER CONTROL PANEL



Typical GA Drawing of Transformer Control Panel (2 BUS)



Typical GA Drawing of Transformer Control Panel (3 BUS)