



**GUJARAT ENERGY TRANSMISSION
CORPORATION LTD.**

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

TECHNICAL SPECIFICATIONS
FOR
NUMERICAL BUSBAR PROTECTION PANELS

GETCO / E / TS- BBP / 3606 / R3 July, 2022

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SECTION-I

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SECTION - II

SPECIFICATION FOR NUMERICAL BUS BAR PROTECTION PANELS

1.0 SCOPE

- 1.0.A 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 Busbar Protection Panels as detailed in the Schedule 'A' & 'G'.**
- 1.1.2 Design and manufacture of Numerical Bus Bar Protection Panel to meet the requirements of Protection of Bus Bar up to 400kV level.
- 1.1.2.1 Design and fabrication of Numerical Bus Bar Protection Panel along with all necessary accessories like switches, indicating LED etc. to provide self contained and ready to use Numerical Bus Bar Protection Panel as per this specification.
- 1.1.3 Complete testing at manufacturer's works.
- 1.1.4 F.O.R. destination supply of completely assembled Numerical Bus Bar Protection Panel.
- 1.1.5 **Supervision of** Testing and Commissioning of these Numerical Bus Bar Protection Panel at site.
- 1.1.6 It is not the intent to specify completely all the details of the design and construction of Numerical Bus Bar Protection Panel. However, the Numerical Bus Bar Protection Panel 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 Numerical Bus Bar Protection Panel 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.

2.0.A Recommended spares:

The Bidder shall furnish in his offer, a list of recommended spare with unit rates for Numerical Bus Bar Protection 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.

3.0 STANDARDS:

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.

4.0 PRINCIPAL TECHNICAL PARAMETERS:

The Numerical Bus Bar Protection Panel covered in these specifications shall have the technical requirements listed in Annexure – III.

5.0 GENERAL TECHNICAL REQUIREMENTS:

5.1 SCOPE OF WORK.

- 5.1.1 Supply of Numerical Bus Bar Protection Panel as specified in accompanying Schedule-A and together with such auxiliary equipment and materials as required. The Bidder shall indicate make, type and designation of each Numerical Bus Bar Protection Panel in the bid.
- 5.1.2 Complete internal wiring of equipment and terminal blocks. Design and manufacture of relays and relay assemblies to meet the requirement of Busbar protection scheme.
- 5.1.3 Preparation and furnishing of all the required drawings. All wires shall be ferruled at both ends even on shorting links also and shall be clearly shown in the schematic drawings.
- 5.1.4 Testing of Numerical Bus Bar Protection Panel and associated equipment and furnishing of test certificates.
- 5.1.5 Preparation and furnishing of commissioning instructions, operation and maintenance manuals with all operational features/optional features.
- 5.1.6 **Supervision of Testing and Commissioning of the supplied Numerical Bus Bar Protection Panel at site.**
- 5.1.7 The successful Bids have to submit three sets of all types of drawings, operation and maintenance manuals.

5.2. GENERAL REQUIREMENT FOR THE NUMERICAL BUS BAR PROTECTION PANEL:

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.

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.

Numerical Busbar Protection panel shall be 'Simplex' type with front opening only and overall panel dimensions 2312mm H (Height-H) x 750mm D (Depth-D) x 800mm W (Width - W). or front / rear opening and overall panel dimensions 2312mm H (Height-H) x 750mm D (Depth-D) x 900mm W (Width - W), as specified in Schedule – A.

The panels shall be modular rack mounting type consisting of standard width racks, in accordance with the IEC – 297. The relays shall be suitable to form 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 panel shall have full transparent (Perspex) front door with lockable handle.

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).

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

Purchaser's external cable connection will be terminated on the terminal blocks to be provided by the bidder in panels. Cable entries to the panels shall be from the two numbers of screwed type removable gland plates in panel bottom. Each of size not less than 350mm x 200mm with punched hole for suitable size cable glands

5.2.0 RELAYS:

5.2.1 All relays shall confirm to the requirements of IS/IEC or other applicable standards as mentioned in Annexure-II. Relays shall be suitable for flush or semi-flush mounting on the front with connections from the rear.

5.2.2 All AC operated relays shall be suitable for operation at 50 Hz. AC voltage operated relays shall be suitable for 110V VT secondary and current operated relays for 1 or 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.

- 5.2.3 The Numerical Bus Bar Protection Panel 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 Numerical Bus Bar Protection scheme and monitoring of control supplies and circuits etc. also required for the complete protection schemes described in the specification shall be provided. All Numerical Bus Bar Protection scheme 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.
- 5.2.4 All Numerical Bus Bar Protection scheme, auxiliary relays and timers except the lockout relays and interlocking relays specified shall be provided with self-reset type contacts. All Numerical Bus Bar Protection relay and timers shall be provided with externally hand reset positive action operation indicators with inscription. All Numerical Bus Bar Protection relays which do not have built-in hand-reset operation indicators shall have additional auxiliary relays with operating indicators (flag relays) for this purpose.
- 5.2.5 No control relay which shall trip the power circuit breaker when the relay is de-energized shall be employed in the circuits.
- 5.2.6 Provision shall be made for easy isolation of trip circuits of each relay for the purpose of testing and maintenance.
- 5.2.7 Auxiliary seal-in-units provided on the Numerical Bus Bar Protection scheme shall preferably be of shunt reinforcement type. If series, relays are used the following shall be strictly ensured.
- a) The operating time of the series seal-in-unit shall be sufficiently shorter than that of the trip relay in series with which it operates to ensure definite operation of the flag indicator of the relay.
 - b) Seal – in – unit shall obtain adequate current for operation when one or more relays operate simultaneously.
 - c) Impedance of the seal – in- unit shall be small enough to permit satisfactory operation of the trip coil on trip relays, when the DC supply voltage is minimum.
- 5.2.9 All Numerical Bus Bar Protection scheme shall be provided with one extra isolated pair of contacts wired to terminals exclusively for future use.
- 5.2.10 The setting ranges of the relays offered, if different from the ones specified shall also be acceptable if they meet the functional requirements.
- 5.2.11 Any alternative/additional protections or relays considered necessary for providing complete effective and reliable protection shall also be offered separately. The acceptance of this alternative/additional equipment shall lie with the GETCO.

5.2.12 - Deleted -

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

5.2.14 Where ever numerical relays are used, the scope shall include the following:

- a) Necessary original licensed copy of software and hardware to up/down load the data to/from the relay from/to the personal computer installed in the sub station shall be provided. Relay shall be looped by Fiber Optic/ twisted wire Cables up to PC. However, the supply of PC is not covered under this clause.
- 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 oscillographic records in standard COMTRADE format. The software shall be suitable to provide oscillographic 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 for future connectivity to SCADA. The relay shall be capable of supporting communication protocols, as specified in 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 latest version of all the software (License copy for each relay), IO Cards, required cable for local or remote communication mentioned in the catalogue including all optional items.

5.3 Internal Wiring:

5.3.1 All wiring shall be carried out with 1100V grade single core multi strand flexible copper conductor wires with FRLS insulation and shall be 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 secondary connections. The multi-strand copper conductor used for internal wiring shall be as follows:

- a) All circuits except transformer circuit one 1.5mm² per lead
- b) Current transformer circuit one 2.5mm² per lead.

5.3.2 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.

- 5.3.3 Panel wiring shall be securely supported, neatly installed by lacing and tying, 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.
- 5.3.4 An accidental short circuiting of certain wires, e.g. positive and negative wires, is likely to result in malfunction of equipment, such as closing or tripping of a breaker. So, these wires shall not be terminated on adjacent terminal blocks.
- 5.3.5 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.
- 5.3.6 Wire termination shall be made with solder less crimping type of tinned copper lugs, which firmly grip the conductor and insulation. 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.
- 5.3.7 The bidder shall be responsible for the completeness and correctness of the internal wiring and for the proper functioning of the connected equipment.
- 5.3.8 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.

5.4 Earthing:

- 5.4.1 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 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.
- 5.4.2 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.
- 5.4.3 Looping of earth connections, which could 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.
- 5.4.4 A separate earthing point shall be provided in the panel for cable screens of static equipment, insulation between two earths 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. Purchaser shall carry out connection of this earth point to the station earth.

5.5 Terminal blocks:

- 5.5.1 Terminal blocks shall be 800 V grade, 45 amps rated, one piece molded, complete with insulated barriers, stud type, in 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.
- 5.5.2 Terminal blocks for CT secondary leads and auxiliary AC/DC shall be provided with test links and isolating facilities i.e. disconnecting link type TBs. CT secondary wiring should be such that additional circuit in series can be added in future.
- 5.5.3 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.
- 5.5.4 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.
- 5.5.5 Unless otherwise specified, terminal blocks shall be suitable for connecting the existing conductors of purchaser's cables on each side.
- 5.5.6 All circuits except CT circuits shall be minimum of one of 2.5mm² copper & all CT circuits minimum of two of 2.5mm² copper and all PT circuits minimum of two of 2.5 mm² copper.
- 5.5.7 There shall be minimum clearance of 250mm between the 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.
- 5.5.8 Molding materials shall be self extinguishing or resistant to flame propagation, substantially non hygroscopic 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.
- 5.5.9 Protective transparent covers of easily removable plastic for placing over the live parts of the terminal blocks shall be provided invariably.

5.6 Painting:

- 5.6.1 All sheet steel work required for blanking the space of panel shall be phosphated in accordance with the following procedures and in accordance with IS: 6005 'Code of Practice for phosphating iron and steel'.
- 5.6.2 Oil, grease, dirt and swart shall be thoroughly removed by emulsion cleaning.
- 5.6.3 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.

- 5.6.4 After phosphating, through rinsing shall be carried out with clean water followed by final rinsing with dilute bi-chromate solution and oven drying.
- 5.6.5 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.
- 5.6.6 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 eggshell white.
- 5.6.7 Each coat of primer and finishing paint shall be of a slightly aesthetically pleasing appearance free from dirt and uneven surface.
- 5.6.8 The paint thickness shall be 60-100 microns for powder coating.

5.7 Mounting:

- 5.7.1 All equipment on front of panel shall be mounted flush on rack.
- 5.7.2 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.
- 5.7.3 No equipment shall be mounted on the doors without prior approval of the purchaser.

5.8 Indicating lamps:

- 5.8.1. 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.
- 5.8.2. 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.
- 5.8.3. Multi LED with uniform bright illumination shall be provided. The wattage of the LED lamps shall be less than 0.6 W.
- 5.8.4. Indicating lamp for Busbar Zone position shall be provided. The colour of the 'In and Out position shall be red and green respectively.

5.9 Annunciation System

(Required only in case of Bus Bar Protection panels for existing Sub station)

- 5.9.1. 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.
- 5.9.2. 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 port (RS232 to RS 485) output for computer connection. It shall have repeat relay card AC/DC fail facility and LED fascia. 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

- 5.9.3. 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.
- 5.9.4. Annunciator fascia unit shall have translucent plastic windows for each alarm point. Annunciation fascia shall be engraved in black-in-white lettering for NON TRIP alarm and black-in-red lettering for TRIP alarm.
- 5.9.5. 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'.
- 5.9.6. 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.
- 5.9.7. 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 vice versa.

- 5.9.8. Unless otherwise specified, one alarm hooter and bell common to annunciator on all the panels shall be provided.
- 5.9.9. Each annunciator shall be provided with accept, reset and test push buttons.
- 5.9.10. 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.
- 5.9.11. 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.
- 5.9.12. 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.
- 5.9.13. Provision of testing facilities for flasher and audible alarm circuit of annunciator shall also be made.
- 5.9.14. The annunciation shall be of repetitive type and shall be capable of registering fleeting signal registered by the system shall be of 15ms.
- 5.9.15. 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.
- 5.9.16. The annunciation in fascia shall be grouped for trip in one / more row and non trip be grouped in balance rows.
- 5.9.17. The spare fascia window provided should have facility to engrave the inscription on site.
- 5.9.18. The annunciator shall have minimum 3 windows per bay unit and 8 windows for central unit.

5.10 Test Blocks:

Switch board type, back connected, semi-flush mounting type test blocks having voltage 1100V and current rating 45A shall be provided with links or other devices to enable insertion of a device into the circuit without causing open circuit secondary of CT or to enable short circuiting of secondary of the C.T.

Test blocks shall facilitate complete isolation of relays, so that power for testing can be supplied either from the instrument transformers or from an external source.

Individual test block for each bay unit shall be provided. If any test plugs are to be used with the test blocks, Three test plugs shall be supplied free of cost with main equipment.

5.11 Space Heaters:

Tubular space heaters of 60 watts with thermostat control of suitable rating for connection to single phase, 240 Volts, A.C. Supply complete with switches conveniently located, shall be provided at the bottom of the cubicle to prevent condensation of moisture. The loss of power shall be low enough to keep the temperature of surface well below permissible limits.

5.12 Switch Board Lighting :

The switch board shall be illuminated by 11 W CFL with fixture connected to 240 Volts, 1-Ph, 50 Hertz AC supply. These lights shall be operated by door operated push button switches.

6.0 TESTS:

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 Busbar Protection Panel

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 dependence
- iv. Rated burden
- v. Mechanical Endurance test
- vi. 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

Important Note :

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.

6.1 Acceptance and routine tests.

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

Immediately after finalization of the programme 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.

6.2 QUALITY ASSURANCE PLAN:

- 6.2.1 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.
- 6.2.2 Precaution taken for ensuring usage of quality raw materials and sub-components shall be stated in the quality assurance plan.
- 6.2.3 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.

6.2.4. - Deleted -

7.0. 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.**

8.0. DOCUMENTATION:

The **successful** Bidder shall furnish as a part of their offer, complete set of technical literature/ manuals, and typical schematic drawings in respect of each Numerical Bus Bar Protection panel offered by them.

The successful Bidder has to submit detailed Manufacturing Quality Plan (MQP) and drawings of Busbar protection panels in three sets for approval. On approval final drawings in hard as well as soft (AutoCAD) shall be submitted.

The successful Bidder has to provide instruction manual, all drawings, literature etc. for all Numerical busbar protection scheme, write up for testing and commissioning procedures, setting calculations etc. detailed circuit diagrams with trouble shooting protocols to all consignee destinations as well as to the CE(Engineering), CE (Projects) and the SE(Testing) GETCO, HO, VADODARA

8.0 (A) - Deleted -

9.0 PACKING AND TRANSPORT:

- 9.1 All Numerical Bus Bar Protection panel/ 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 Numerical Bus Bar Protection panel 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.
- 9.2 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.
- 9.3 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 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
- 9.4 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.

10.0 **SCHEDULES:**

- 10.1 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 Busbar panels.

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

- 10.4 - Deleted -

11.0 **INFORMATION TO BE FILLED IN INVARIABLY BY THE BIDDER:**

For ready reference of the purchaser, the items of information 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. 8.0

- 12.0 - Deleted -

13.0 **GUARANTEE FOR MAINTENANCE SPARES AND SERVICES:**

The bidder shall guarantee for supplying maintenance spares and services as well as repairing of Numerical Bus Bar Protection Panel for a period of the life expectancy of 25 years.

14.0 **Training**

- 14.1 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 Two days, at free of cost.

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

- 14.2 - Deleted -

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

15.0 **REQUIREMENT FOR FIRST TESTING AND COMMISSIONING**

- 15.1 Any modifications required by the purchaser at site shall be carried out by the successful bidder at the time of commissioning, free of cost.

15.2 The successful bidder has to provide reproducible tracings / soft copy for all the drawings as a part of supply contract to the CE (Project) GETCO, Corporate office, VADODARA for documentation.

15.3 - **Deleted** -

15.4 The successful bidder has to do **supervision of** first testing/commissioning of each Numerical busbar protection scheme, by deputing his Service Engineer free of cost at each site.

ANNEXURE: II**NUMERICAL BUS BAR PROTECTION RELAYS – LIST OF STANDARDS**

Sr. No.	Standard No.	Title
1	IEC 60255-6	Thermal requirements Mechanical requirements Limiting dynamic value Accuracy requirements Rated Burden
2	IEC 60068-2	Climate Test.
3	EN 60068-2	Thermal withstand of insulating materials.
4	IEC 60255-5 IEC 60950	Insulation resistance test, Dielectric test, Impulse test and Clearance and Creepage distances.
5	IEC 60255-22 EN 50263 IEC 61000-4	High frequency test Immunity test, Electrostatic discharge test, Fast transient test, Power frequency magnetic field immunity test, Radio frequency interference test.
6	EN 55022	Emission test.
7	IEC 60255-21	Vibration and Shock.
8	IEC 60255-11	Interruption to and alternating component in DC aux. Energizing quantity
9	IEC 61850-8-1	Inter bay bus supports protocols
10	IS-3231	Electrical relays for power system protection.
11	IEC-255 Part 1 to 3	Electrical relays for power system protection.
12	BS – 142	Electrical relays for power system protection
13	BS – 152	Relay coding, auxiliary wiring and panel and wiring.
14	IS – 8686	Static protective relays
15	IS – 2147	Degree of protection for cubicles
16	IS – 5	Colour for ready mixed paints and channels.
17	IS – 1554 Part-I, 1988	PVC insulated cables up to and including 1000 volts.
18	IS – 3842 Part- II to IV	Application guide for protection
19	IS – 9224 Part- II	HRC Cartridge fuses links.
20	IS – 6005	Code of practice for phosphating iron and steel
21	IS-5578	Guide for making of insulated conductors.
22	IS – 11353	Guide for uniform system of marking and identification of conductors and apparatus terminals.
23	IS – 2206	Fuses
24	IEC – 801-4	Electrical heat transient bursts.
25	IS-694	PVC insulated cables for & including working voltages up to 1100 volt

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	Electromagnetic emission tests - Conducted emission test - Radiated emission test
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
Safety Test		
1.	IEC61010-1	Single fault condition assessment Earth bonding impedance test Mechanical resistance to shock and impact - Rigidity test - Impact hammer test Protection against electrical shock Protection against the spread of fire

Degree Of Protection Test		
1.	IEC 60529	Degree of Protection Provided by enclosure test

ANNEXURE: III
PRINCIPAL TECHNICAL PARAMETERS OF NUMERICAL BUS BAR RELAYS

SR. NO.	Item	Specification
1.	NUMERICAL BUS BAR PROTECTION RELAYS	Numerical Bus Bar Protection scheme shall cover all the main & auxiliary buses and circuits (Bays). The scheme shall be suitable for main – I, main – II and transfer bus (If applicable). 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 be for additional two bays as per station layout, however central unit shall be compatible for minimum 24 bays and busbar protection scheme shall be upgradeable accordingly. 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 distributed structure comprising a Central Unit and Bay Units. All the Bay Units and the Central Unit shall be located in Busbar 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) Where suppliers are offering check zone feature for the low impedance bus bar protection, have to prove that check zone will operate reliably under all conditions and for all internal faults. u) The Bus bar Protection shall be insensitive to transients and harmonics and be fully reliable and selective even under CT saturation conditions. v) 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. w) The numerical bus bar protection shall be with extensive self-supervision and diagnostic facilities.
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		x) The HMI programme should graphically display the bus bar configuration and the bus bar image. The HMI programme shall facilitate setting of the protection and read out of various information such as bus differential current in each zone, phase currents, positions of the isolators & breakers, etc. The HMI programme shall also permit dialogue with the protection from a remote location without the need for additional software. The HMI programme should be based on MS Windows environment. y) The HMI programme 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 programme the output relays to be of the latched or non-latched type. z) The Bus bar Protection shall include a Disturbance Recorder function in central unit as well as 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. aa) 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. bb) The Disturbance Recorder and Event Recorder buffer memory shall be of non-volatile type and shall not require the use of batteries. cc) When the bus tiebreaker is equipped with one set of CT's only and when the bus tiebreaker 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 tiebreaker is in open position and a fault occurs between the CT and the bus tiebreaker, the faulted bus section is selectively tripped and isolated without any delay. The healthy bus section will not be tripped. dd) A Local Display Unit (LDU) shall be provided on the Central Unit and on each Bay Unit. ee) The LDU on the Central Unit shall permit read out of the following information: • Differential currents in each Bus bar zone and each phase on line as well as at the time of fault. • Alarm conditions • Trip conditions
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		• 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 ff) 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 gg) 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. hh) Shall have immunity against system transients. ii) Include continuous DC supply supervision. jj) Incorporate clear zone indication. kk) 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. ll) Trip both the breakers i.e. the breakers being bypassed and the transfer breaker if the bus fault occurs during the change over operation. mm) Have provision to reset trip bus through a single push button to be provided for the purpose. nn) 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. oo) 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.
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		pp) Be supplied along with all suitable Original Customized licensed software & communication cable for local and remote communications, analysis of fault etc. qq) 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 Check Zone: 8. Min fault current pick-up: 500 to 6000 A (I_{kmin}) In steps of 100 A 9. Stabilizing factor (K): 0.0 to 0.9 in steps of 0.05 10. 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 4. 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
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		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: 8 Opto-couplers 10. Pickup current for I/P: ≥ 10 mA 11. Operating Time for I/P: < 1 s 12. Nos of Output – Bay unit: 16 Nos 13. Nos of Output – Central Unit: 08 Nos 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 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 (for existing sub station), SNTP (for new sub station). Communication ports : • Front - RS232 / RJ45 / Optical • Rear - Fiber optic / RJ45
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SCHEDULE – B**GUARANTEED TECHNICAL PARTICULARS****(TO BE FILLED IN BY THE BIDDER AND FURNISH WITH TECHNICAL BID)**

The GTP is to be filled up in this format 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 shall fill in the particulars against appropriate items in respect of each rating and type of Numerical Bus Bar Protection scheme offered in the broad categories. **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 exact value/s must be filled in.**

A	<u>CONTROL AND RELAY PANEL</u>	
i	Make	
ii	Panel Details 1. Type of panel (Simplex, Front Openable, Modular, Rack mounting) 2. Equipment mounted on which side of the panel 3. Full transparent (Perspex) front door with handle 4. Thickness of sheet steel (a) Front (b) Door Frame (c) Base Frame (d) Side (e) Cubicle roof (f) Door 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 Overall dimensions	
v	GA drawing no. attached.	
vi	Mounting details	
vii	Other details, if any.	
B	<u>PANEL WIRING</u>	
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) CT Circuits 2) DC supply circuits 3) Other circuits	
v	Colour code of wiring for following. 1) CT Circuits	

	2) DC supply circuits 3) Other circuits	
vi	Type of Lugs, Sleeves and Ferrules to be used for panel internal wiring.	
C	<u>TERMINAL BLOCKS</u>	
i	Disconnecting TB - Make & Model Type	
ii	Non-Disconnecting TB - Make & Model Type	
iii	Construction details	
iv	Voltage grade	
v	Current rating	
vi	Type of TB for CT and other wiring.	
vii	No. of spare terminals.	
D	<u>EARTHING</u>	
i	Material and Size of the earth bus	
ii	Provision for inter panel connection	
iii	Conductor or material used for earthing	
iv	Size of the earthing wire	
v	Colour and size of the wire used for earthing of different devices in the panel to the earthing bar.	
E	<u>INDICATING LAMPS - LED</u>	
i	Make, Type and Size of lamps	
ii	Colour of Lamps	
F	<u>ANNUNCIATORS</u>	
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 port (RS232 to RS 485) output for computer connection 8. It shall have repeat relay card 9. AC/DC fail facility and LED fascia 10. Windows based PC software 11. Cables, converters etc. shall also be provided	
iv	No. of Windows	
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	
G	<u>TEST TERMINAL BLOCKS</u>	
i	Make, Type and Rating	
H	<u>PANEL ILLUMINATION</u>	
i	Make, Type and Rating	
I	<u>BUS BAR PROTECTION RELAYS</u>	
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) 3. CT Ratio matching range	
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. 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: 12. Nos of Output – Bay unit: 13. Nos of Output – Central Unit:	
viii	Auxiliary Supply: 1. Input Voltage:	

	2. Load: (Bay Unit) (Central Unit) 3. Front plate Signal 4. Switch	
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 inter bay bus supports. 4. Time synchronization via IRIG-B.	
xiii	Communication ports : • Front - RS232 / RJ45 / Optical • Rear - Fiber optic / RJ45	
xiv	Maximum fault current for which 100% stability can be achieved.	
xv	Impedance type and operating characteristic	
xvi	Continuous supervision of CT secondary against open circuit	
xvii	Architecture & Interconnection of Central unit and bay unit panel.	
xviii	Principle of CT ratio error matching	
xix	Measuring and tripping criterion	
xx	HMI details	
xxi	Self supervision and diagnostic facility.	
xxii	Measurements available	
xxiii	Whether bus bar image for each bay is formed and displayed in HMI	
xxvi	Redundant hardware available	
xxvii	Standard functions available	
xxviii	Optional functions available	
xxix	Reset through a single push button	
xxx	Future configuration and activation of new bays should be possible	
xxxi	Filtering and evaluation of Analogue qty at bay level	

xxxii	Tripping to trip coil directly from Bay units	
xxxiii	Connection and communication between Bay unit and Central unit	
xxxiv	Blocking of zone in case of communication failure and annunciation thereof	
xxxv	Isolator integrity monitoring through software without any external relay and annunciation thereof	
xxxvi	DR/Event function in CU as well as BU with non volatile buffer memory	
xxxvii	DR Sampling freq. And total duration	
xxxviii	Nos of events	
xxxix	Availability of Blind zone detection & CB failure feature	
xxxx	Differential current display of each zone	
xxxxi	Continuous DC supervision	
xxxxii	Central unit compatibility	
xxxxiii	Availability of Current reversal technique for Bus Coupler bay	
xxxxiv	Any deviations	
xxxxv	Any other details	
G	<u>GENERAL</u>	
i	Whether agreed for first testing/commissioning of each Numerical busbar protection scheme, by deputing his Service Engineer free of cost at each 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 sighed attached.	
vi	-Deleted-	
vii	SPARES: Whether list of recommended spares furnished.	

SCHEDULE: G
(Bill of Material for Numerical Bus Bar Protection Panel)
(TO BE FILLED IN BY THE BIDDER)

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