GUJARAT ENERGY TRANSMISSION CORPORATION LTD.

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

TECHNICAL SPECIFICATIONS

FOR

PROTECTION RELAYS FOR 66 kV SYSTEM

GETCO / E / TS-CRP 3604A / R3 May,2025

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SECTION: I

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SECTION - II

TECHNICAL SPECIFICATIONS FOR PROTECTION 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, manufacture, testing at manufacturer's works and supply of the Protection Relays as detailed in the Schedule 'A' or Technical Specifications of 66 kV Control & Relay Panels, as the case may be.

1.1.2 Design and manufacture of Protection Relays to meet the requirements of Protection of power system elements / equipments viz.

a) 66kV feeders, Capacitor Banks
b) 66kV side of 220/66kV, 132/66kV, 66/11kV Auto/Two winding transformers

1.1.2.1 Design and fabrication of Protection Relays along with all necessary accessories like switches, HMI, indicating LEDs etc. to provide self contained and ready to use Protection Relays as per this specification.

1.1.3 Complete testing at manufacturer's works.

1.1.4 F.O.R. destination supply of completely assembled Protection Relays.

1.1.5 Supervision of testing and commissioning of these Protection Relays at site.

1.1.6 It is not the intent to specify completely all the details of the design and construction of Protection Relays. However, the Protection Relays shall conform in all respects to high standards of engineering, design and workmanship, meeting the GTP requirement as per clause 4.0 and shall be capable of performing continuous industrial operation in a manner acceptable to the purchaser, who will interpret the meaning of drawings and specifications. The purchaser has the power to reject any work or material which, in his judgment, is not in accordance therewith. The offered Protection Relays shall be complete with all components necessary for their effective trouble free operation. Such components shall be deemed to a part of scope of supply whether those are specifically brought out in this specification and/or in the commercial order or not.

2.0 SCHEDULE OF REQUIREMENT

2.1 The Consignee Details / Delivery Instructions shall be issued by CE (Project) / ACE (Testing), GETCO, Corporate office, Vadodara, to the successful bidder after successful inspection and testing of all relays & equipments at manufacturer's works.

2.2 Any special tools, jigs and testing equipment, if required for the maintenance / testing of the equipment offered shall be quoted as optional items. Unit prices of such equipment shall be quoted.

2.3 Recommended spares

The Bidder shall furnish in his offer, a list of recommended spare with unit rates for protection relays 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 Protection Relays shall conform to the upto date version of all relevant standards.

4.0 PRINCIPAL TECHNICAL PARAMETERS:

The Protection Relays covered in these specifications shall have the technical requirements listed in Annexure – II.

5.0 GENERAL TECHNICAL REQUIREMENTS:

5.1 SCOPE OF WORK.

5.1.1 Supply of Protection Relays as specified in accompanying schedule `A' or Technical Specifications of 66 kV Control & Relay Panels, as the case may be and in this specification together with such auxiliary equipment and materials as required. The Bidder shall indicate make, type and designation of each Protection Relays in the bid.

5.1.2 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.

5.1.3 Testing of Protection Relays and associated equipments at work and furnishing of test certificates

5.1.4 Preparation and furnishing of commissioning instructions, operation and maintenance manuals with all operational features & optional features.

5.1.5 The successful bidders have to submit Three sets of drawings i.e. GA, Cutout and Relay Terminal Diagram, Schematics and Operation & Maintenance manuals in hard & soft copies. One such set shall be supplied along with each relay.

5.2 GENERAL REQUIREMENT FOR THE PROTECTION RELAYS:

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.

5.2.1 The relays shall confirm to the requirements of IS: 3231/IEC-60255/IEC-61000 or other applicable standards. Relays shall be suitable for flush or semi-flush mounting on the front of the panel with connections from the rear.

5.2.2 The relays shall be suitable for VT secondary of 63.5V & 110V and CT secondary current of 1 or 5 amp, 50Hz. The relays shall be suitable for auxiliary DC supply voltage of 110V or 220V, as specified in 'Schedule A'. The 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 protection 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 protection relays, monitoring of control supplies & circuits etc, and also required for the complete protection schemes described in the specification shall be provided. All protection 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. The contacts shall be of silver plated copper 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 protection relays, auxiliary relays and timers except the lockout relays and interlocking relays specified shall be provided with self-reset type contacts. All protection relays and timers shall be provided with externally hand reset, positive action operation indicators with inscription. All 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 Timers shall be of continuous rating. Time delay in terms of milli second obtained by the external capacitor resistor combination is not acceptable. The variable pot type timer is not acceptable.

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

5.2.7 All protection relays shall be provided with one extra isolated pair of contacts wired to terminals exclusively for future use.

5.2.8 For numerical relays, the scope shall include the following.

a) Necessary original customized licensed software and hardware to upload / 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, if DR facility is available then retrieval of 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 curves with time base phasor diagram, locus diagrams, harmonic graphs, etc. Automatic download of DR files should also be possible. The software shall be suitable for creating / modifying logics of the protection relay.

c) The relay shall have communication facility with RS232/RS485/RJ45/USB port for local communication with Computer.

d) The quantity of communication cable and converter (if any) to be supplied to connect the relay with Computer shall be as indicated in Schedule 'A' of respective tender or 1 No. / 10 Nos. of Control & Relay Panels**.**

5.2.9 -Deleted-

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

6.0 TYPE TESTS:

6.0.1 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. 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

6.0.2 Important Note :

In case of non-submission / partial submission of 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.

Immediately after finalization of the programme of acceptance testing, the supplier shall give two weeks advance intimation to the purchaser to enable him to depute his representative for witnessing the tests.

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

The tests shall be carried out with Numerical Relay Testing Kit at the Supplier's works.

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 equipments/components.

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.

6.3 INSPECTION;

6.3.1 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.

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

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

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

7.0 PERFORMANCE GUARANTEE

All relays 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 or guarantee period 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 relay at the site**.**

8.0 DOCUMENTATION:

The bidder shall furnish as a part of their offer, complete set in duplicate of technical Literature/manuals (one copy shall invariably the original & not the photo copy), and one set of typical schematic drawings in respect of all relays/schemes offered by them.

After issue of detailed purchase order, the successful bidder shall submit Three sets of drawings, literature and manuals along with detailed bill of material for approval to the CE (Projects), GETCO , Sardar Patel Vidyut Bhavan, Race Course, VADODARA -390 007.

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. Any manufacturing not as per the approval, shall be at the supplier's risk.

The successful bidder shall provide set of approved drawings, technical literature and commissioning manuals (Hard as well as soft copy) to each consignee. These shall be as per clause no.5.1.5

8.01 List of drawings to be submitted by successful bidder

1. Front view showing all Input, Output and Communication ports
2. Rear view showing all Input, Output and Communication ports.
3. Top view
4. Terminal diagram
5. Electrical connection diagram
6. Functional diagram
7. Technical Data sheet
8. Cutout details
9. Housing / mounting arrangement drawing
10. Ordering code details

9.0 PACKING AND TRANSPORT

9.1. All Protection Relays / 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 Protection Relays 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/Substation of which the material in the package forms part of and any handling & unpacking instructions considered necessary. Any material found short inside the intact packing cases shall be supplied without any extra cost.

9.3 The successful 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 protection 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.

i) Manual, software CD & communication cable.

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

10.2 - Deleted –

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

a. 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' (Guaranteed Technical Particulars)
2. Documents and drawing listed in Clause no. 8.0

b. GUARANTEE FOR MAINTENANCE SPARES AND SERVICES:

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

13. GENERAL:

13.1 The successful bidder has to provide soft copy for all the drawings as a part of supply contract to the CE (Projects), GETCO, HO, VADODARA for documentation.

13.2 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, etc. to all consignee destinations as well as to the ACE (Testing), GETCO, and the CE.(Projects) GETCO, HO, VADODARA

13.3 The successful bidder has to impart training on each type of protection relay to be supplied, to GETCO engineers at each circle (13 Nos) at GETCO site by deputing his Service Engineer free of cost. The retrofitting of the relays is not in the scope of the supplier. The programme of the training shall be mutually discussed and finalized by purchaser with suppliers.

13.4 The successful bidder has to depute his service engineer for supervision of testing and commissioning of relays at free of cost.

ANNEXURE: I
PROTECTION RELAYS – 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.	BS – 152	Relay coding, auxiliary wiring and panel and wiring.
9.	IS – 8686	Static protective relays
10.	IS – 2147	Degree of protection for cubicles
11.	IS – 5	Colour for ready mixed paints and channels.
12.	IS – 3842 Part- II to IV	Application guide for protection
13.	IS – 6005	Code of practice for phosphating iron and steel
14.	IS-5578	Guide for making of insulated conductors.
15.	IS – 11353	Guide for uniform system of marking and identification of conductors and apparatus terminals.
16.	IS – 9482-1980	Characteristics values of input and outputs of single side band PLCC terminals.
17.	IS- 9528 Part-1 and 2	Planning of (single side band) power line carrier systems.
18.	IS – 10706 – 1983	Methods of tests for single side band PLC terminals.
19.	IS-8997-1978	Coupling device for PLC systems (note This is to be referred for the PLCC terminal connections.
20.	IEC-686-1	Transducers
21.	IS – 2206	Fuses
22.	IS – 9000	Dry heat test
23.	IEC – 801-4	Electrical heat transient bursts.
24.	IS 694	PVC Insulated cable for working voltage up to & including 1100 volt.

List of 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: II

PRINCIPAL TECHNICAL PARAMETERS OF RELAYS

SR. NO.	Item	Specification
1	**Differential Protection Relay**	**(A) Features** **1. % Biased Differential Protection** i). Be high speed with an operating time of less than 30 ms at 5 times the set current. ii). Shall have principle of biased differential type with high set feature and adjustable slope characteristic. iii). Shall be numerical type. iv). Shall have true RMS measurement. v). Shall have continuous self monitoring and diagnostics features. vi). Shall have ratio and phase angle matching through software. vii). Shall have site selectable CT secondary 1 & 5 A viii). Be suitable for three phase two winding transformer. ix). Be stable on heavy through faults. x). Be immune to magnetizing inrush current. xi). Have features to provide stability under over excited conditions and have 2nd harmonic restraint features. xii). Shall have the following functions. i. Differential Protection ii. Restricted Earth Fault Protection. iii Breaker Failure Protection xiii). Be triple pole type with faulty phase identification / indication. xiv). 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. xv). Be supplied along with all suitable Original Customized licensed software & communication cable for local and remote communications, analysis of faults, etc. xvi). Have a local Human Machine Interface (HMI) comprising of 2-3 line alphanumeric LED/ LCD readable display and a soft touch key pad to access to settings, events and records. xvii). Have a front RS232/RJ45/USB communication port for using a computer for local access to settings, events and recorders. xviii). Have rear RS485 communication port to support all the facilities available via the integral user interface or communication based on IEC60870-5-103 connectivity.

		xix). Have a disturbance recording feature to record graphic form of instantaneous values of current in all windings in 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. HV Each Breaker status i.e. 1 no. input b. LV Each Breaker status i.e. 1 no. input c. Buchholz / OLTC Buchholz alarm / trip i.e. 4 no. inputs. d. WTI/OTI/PRV alarm / trip of transformer. e. External signals as per CRP schematics as finalized during detailed engineering. xx). Have internal battery used to backup the clock and other circuits like switching status, fault indication etc. The battery shall be reliable and long lasting. There shall be an alarm and indication for declining battery status. xxi). DR & SER shall have date & time stamping xxii). Storage capability of DR - Minimum 08 Nos. of DR (Duration of each DR shall be 1 Sec). DR shall be triggered internally as well as through external binary inputs. **2. Restricted Earth Fault Protection feature** i). Be single pole type ii). Be high impedance differential protection (Necessary stabilizing resistor and voltage limiting non-linear resistor shall also 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 faults. **3. Breaker Failure Feature** i). Shall provide backup 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. iv) Shall initiate Breaker Failure Protection internally as well as via external input. **(B) Technical Parameters:**

		1. Analogue Inputs: (i) Rated Current : 1A & 5A (site selectable), 50 Hz ±2.5 Hz (ii) Rated Burden : <0.2VA/0.5 VA for 1/5 Amp (iii) Over load capability: 3xIn - continuous 100xIn - 1 Sec. 250xIn - Dynamic 2. Auxiliary Supply: 110/220 V DC ±15 % (i) Power consumption: < 15W (ii) Ripple (peak to peak): < 12% **(C) Relay Settings:** 1. Differential Protection Settings: (i) Diff. Current: 10% - 50% In (ii) High Set Diff. Current: 5 – 20 times In (In steps of 0.1) (iii) Bias Diff Current: 10% - 50% In (iv) 2nd Harmonic Restraint : 10 to 30% (v) 5th Harmonic Restraint : 10 to 50% 2. REF Protection Settings: (i) Current Setting : 0.1 to 1 A (in steps of 0.1 A) (ii) Voltage limiting non-linear resistor : (a) Protection Voltage, Vpk >1.5kV (b) Max Voltage Setting : 300V (c) Leakage Current at Max. Voltage Setting : 30mA (e. g. 'Metrosil' make 1088/R2/600A/S1) (iii) Stabilizing resistor : 1000 Ohm, Variable, 200W, 3. LBB Protection Settings : (i) Current Setting: 0.1 to 2 X In (in steps of 0.1 Amp) (ii) Time delay: 0.1 to 2 sec (in steps of 0.02 Sec) **(D) Other Features:** **1. Binary Inputs:** (i) Min 8 nos. and suitable for station Aux. DC Supply (ii) Programmable at site as per requirement (iii) Threshold voltage: > 60 % Aux. DC Supply **2. Output contacts** (i) Trip contacts : Minimum 2 N/O contacts with (a) Continuous carrying Current - 5 A (b) Make & Carry for 0.5 Sec - 20 A (c) Make & Carry for 0.2 Sec - 30 A (ii) Signaling contacts : (a) Minimum 4 Nos and suitable for Station Aux. DC Supply

		(b) Programmable at site as per requirement **3. Communication:** • Front Port - RS232 / USB / RJ45 • Rear Port - RS485 • Protocol - IEC 60870-5-103 **4. Housing** • Flush Mounting • Screw Terminals ('O' Lug for CT Connection) • Degree of Protection IP51 **5. Temperature and humidity** (a) Ambient temp -10 to 55 ^{o}C (b) Relative humidity 10% to 90% Non Condensing (c) Operate range 0-95% (d) Storage temp. -40 to 70 ^{o}C
2	**Directional O/C & E/F Protection Relay**	**(A) Features:** a) Shall be Numerical type. b) Shall have 3 Over Current and 1 Earth Fault element. c) TRUE RMS measurement. d) Have selectable and front panel programmable standard inverse, very inverse, extremely inverse & long inverse IEC / ANSI Characteristic. e) Site Selectable CT Secondary. i.e. 1A & 5A f) High Set Over Current protection with selectable time delay. g) High Set Earth Fault protection with selectable time delay h) Have adjustable characteristic angle, lead / lag, for Directional Over Current/ Earth Fault respectively. i) Shall decide directionality through zero sequence quantity, derived internally. j) Shall have Breaker Failure Protection as in built feature. k) Shall have built in VT supervision feature. l) Include hand reset, programmable as per site requirement, Flag/LED indicators (Min. 08 nos.) for phase identification for all faults and protection operated. m) Have a local Human Machine Interface (HMI) comprising of 2-3 line alphanumeric LED/ LCD readable display and a soft touch key pad to access to settings, events and records. n) Shall be able to store at least last 5 events with fault data viz. Fault current, Faulty Phase etc. with time stamp of 1 ms resolution. o) Shall have in built Disturbance Recorder with total time minimum 5 sec. DR shall be triggered internally as well as through external binary inputs. p) Shall have continuous self hardware & software monitoring and diagnostic features q) shall be communicable type. r) The phase sequence shall be selectable as 'A-B-C' and 'A-C-B'.

(B) Technical Parameters:

1. Analogue Inputs:
   (i) Rated Current: 1A & 5A (site selectable), 50 Hz ±2.5 Hz
   (ii) Rated Burden : <0.2VA/0.5 VA for 1/5 Amp
   (iii) Over load capability: 3xIn continuous
   100xIn 1 Sec.
   250xIn Dynamic
   (iv) Rated Voltage: 110/63.5V, 50 Hz ±2.5 Hz
   (v) Rated Burden: <0.3 VA per phase
   (vi) Over load capability: 2xVn continuous

2. Auxiliary Supply: 110/220 V DC ±15 %
   (i) Power consumption: < 15W
   (ii) Ripple (peak to peak): < 12%

(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 : 0.04 to 2 sec
   (in steps of 0.01 sec)
   (It is inclusive of output contact operating time).
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 ≤ 40ms for 2xIn.
10. LBB Protection Settings :
    (i) Current setting range : 0.1 to 2 X In **(in steps of 0.1 Amp)**
    (ii) Time delay : 0.1 to 2 sec(In steps of 0.02 Sec)

(D) Other Features:

1. Binary Inputs :
   (i) Minimum 5 Nos. and suitable for station Aux. DC Supply
   (ii) Programmable at site as per requirement
   (iii) Threshold voltage: > 60 % Aux. DC Supply

2. Outputs :
   (i) Trip contacts: Minimum 2 N/O contacts with
   (a) Continuous carrying Current - 5 A
   (b) Make & Carry for 0.5 Sec - 20 A
   (c) Make & Carry for 0.2 Sec - 30 A

		(ii) Signaling contact: (a) Minimum 4 Nos. and suitable for Station Aux. DC Supply (b) Programmable at site as per requirement **3. Local PC Communication**: • Front Port - RS232 / USB / RJ45 • Rear Port - RS485 • Protocol - IEC-60870-5-103 **4. Housing** • Flush Mounting • Screw Terminals ('O' Lug for CT Connection) • Degree of Protection IP51 **5. Temperature and humidity** (a) Ambient temp -10 to 55 ^{o}C (b) Relative humidity 10% to 90% Non Condensing (c) Operate range 0-95% (d) Storage temp. -40 to 70 ^{o}C
3	**Non-Directional O/C & E/F Protection Relay**	**(A) Features:** a) Shall be Numerical type. b) Shall have 3 over current and 1 Earth Fault element. c) TRUE RMS measurement. d) Have selectable and front panel programmable **standard** inverse, very inverse, extremely inverse & long inverse IEC / ANSI Characteristic. e) Site 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) Shall have Breaker Failure Protection as in built feature. i) Include hand reset, programmable as per site requirement, Flag/LED indicators (Min. 08 nos.) for phase identification for all faults and protection operated. j) Have a local Human Machine Interface (HMI) comprising of 2-3 line alphanumeric LED/ LCD readable display and a soft touch key pad to access to settings, events and records. k) Shall be able to store at least last 5 events with fault data viz. Fault current, Faulty Phase etc. with time stamp of 1ms resolution. l) Shall have in built Disturbance Recording facility with total time minimum 5 sec. DR shall be triggered internally as well as through external binary inputs. m) Shall have continuous self hardware & software monitoring and diagnostic feature. n) Shall be communicable type. o) The phase sequence shall be selectable as 'A-B-C' and 'A-C-B'. **(B) Technical Parameters:** 1. Analogue Inputs:

		(i) Rated Current : 1A & 5A (site selectable), 50 Hz ±2.5 Hz (ii) Rated Burden : <0.2VA/0.5VA for 1/5 Amp (iii) Over load capability: 3xIn continuous 100xIn 1 Sec. 250xIn Dynamic 2. Auxiliary Supply: 110/220 V DC ±15 % (i) Power consumption: < 15W (ii) Ripple (peak to peak): < 12% **(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 : 0.04 to 2 sec (in steps of 0.01 sec) (It is inclusive of output contact operating time) 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. 10. LBB Protection Settings : (i) Current setting range : 0.1 to 2 X In (in steps of 0.1 Amp) (ii) Time delay : 0.1 to 2 sec(In steps of 0.02 Sec) **(D) Other Features:** 1. Binary inputs : (i) Min 5 nos. and suitable for station Aux. DC Supply (ii) Programmable at site as per requirement (iii) Threshold voltage: > 60 % Aux. DC Supply 2. Outputs: (i) Trip contacts : Minimum 2 N/O contacts with (a) Continuous carrying Current - 5 A (b) Make & Carry for 0.5 Sec - 20 A (c) Make & Carry for 0.2 Sec - 30 A (ii) Signaling contacts : (a) Minimum 4 Nos. and suitable for Station Aux. DC Supply (b) Programmable at site as per requirement 3. **Communication**: • Front Port - RS232 / USB / RJ45 • Rear Port - RS485 • Protocol - IEC-60870-5-103

		4. **Housing** • Flush Mounting • Screw Terminals ('O' Lug for CT Connection) • Degree of Protection IP51 5. **Temperature and humidity** (a) Ambient temp -10 to 55 ^{o} C (b) Relative humidity 10% to 90% Non Condensing (c) Operate range 0-95% (d) Storage temp. -40 to 70 ^{o} C
3a	***Line Differential Protection***	***A. Features:*** ***The relay*** ***1. Shall be numerical type;*** ***2. Shall have true RMS measurement;*** ***3. Shall be working on phase segregated current differential protection principle.*** ***4. Shall have Self-monitoring feature*** ***5. Shall have multiple slope characteristics (preferably) to have stability against CT saturation and heavy faults as well as sensitivity for internal faults.*** ***6. Shall measure Differential as well as restrain current continuously and display the same as measurement.*** ***7. Shall use fiber optic cable or multiplexed digital network to exchange telegraphs.*** ***8. Shall communicate analogue as well as digital signals to remote end.*** ***9. Shall have a capability to communicate to remote end either directly through multimode/single mode fiber optic for direct communication or communication through multiplexer.*** ***10. Shall communicate to remote end through IEEE C37.94 format in case of communication through multiplexer.*** ***11. Shall have single / dual communication channel*** ***12. Shall communicate time coordinated current signals for remote communication to execute Line differential protection algorithm accurately. Time synchronization through GPS / Echo (internal sync. method) shall also be possible.*** ***13. Shall have line charging current compensation feature for batter sensitivity.*** ***14. Shall have built in Dir O/C-E/F Protection feature***

15. ***Dir O/C-E/F function can be utilized as independent or as back up of Differential protection in case of failure of remote communication.***
16. ***Shall have 3 over current and 1 Earth Fault element.***
17. ***Shall have supervision for communication link and able to generate alarm.***
18. ***Shall have selectable and front panel programmable normal inverse, very inverse, extremely inverse & long inverse IEC/ANSI Characteristics.***
19. ***Shall have selectable CT secondary. i.e. 1A / 5A.***
20. ***Shall have high set over current with selectable time delay.***
21. ***Shall have high set Earth fault with selectable time delay.***
22. ***Shall have adjustable characteristic angle, lead / lag, for Dir. O/C-E/F respectively.***
23. ***Shall decide directionality by internally derived zero sequence quantity through software.***
24. ***Shall have built in VT supervision feature.***
25. ***Shall have in built Breaker Failure Protection.***
26. ***Shall include hand reset, programmable as per site requirement, Flag/LED indicators for phase identification for all faults and protection operated.***
27. ***Shall have readable Human Machine Interface with LCD display.***
28. ***Shall be able to store at least last 3 fault records viz. Fault current, Faulty Phase etc with time stamp.***
29. ***Shall have Disturbance Recording facility for minimum 3 sec for each fault. DR can be triggered internally as well as through external binary inputs.***
30. ***Relay offered shall be communicable type.***
31. ***Be supplied with all suitable Original Customized Licensed software & communication cable for local and remote communication, analysis of fault etc.***

B. Technical Parameters:

1. ***Analogue Inputs:***

Rated Current	***1A / 5A (Site selectable), 50 Hz ± 2.5Hz.***
Rated Burden	***<0.2VA / 0.5VA for 1/5 A***
Over load capability	***4 x In Continuous. 100 x In for 1 s. 25 x In for 3 s. 250 x In Dynamic.***
Rated Voltage	***110 / 63.5 V. 50 Hz ± 2.5Hz.***
Rated Burden	***<0.3 VA per phase***
Over load capability	***2 x Vn continuous***

2. ***Power supply:***

Auxiliary Supply	***110 / 220V DC ±15%***
Power consumption	***<15W***
Ripple (peak to peak)	***≤12%***

3. Line Differential Protection Settings:

Minimum operating current	***20 to 200 % of I_n***
Slope (Single / dual)	***10 to 100 % of I_n***
End section (single / dual)	***20 to 1000% of I_n***
Highset operating current	***100 to 2000% of I_n***
2nd Harmonic blocking	***20 to 50 % of I_n***
Typical operating time - ***Normal Diff. operating time*** - ***Highset Diff. operating time***	 ***30 ms*** ***25 ms***
Synchronization Mode	***GPS / Echo (internal sync. method)***

4. Remote Communication:

Analogue signal transfer	***Minimum 3 nos.***
Binary signal transfer	***Minimum 6 nos.***
Remote Communication module	***850/1300 nm – multi-mode OR 1300 / 1550 nm – mono-mode (Finalized during detail engineering)***
Max. Distance Supported	***20km / 40km / higher (As mentioned in price schedule)***

5. Dir O/C – E/F protection settings:

Over current	***50% - 200% (in steps of 5%)***
Earth fault	***5% - 80 % (in steps of 5%)***
Highset over current	***0.5 – 15 times of I_n or more.***
Highset earth fault	***0.5 – 12 times of I_n or more.***
Time multiplier for IDMT	***0.05 – 1.0 (in steps of 0.025)***
Time delay for Highset element	***0.02 to 2 s (in steps of 0.01 s)***
Pick up	***Within 1.1 times of set current value.***
Reset Current	***95% to 90% of pick-up value.***
Operating Time	***As per selectable characteristic.***

		For inst. Element < 40 ms for 2xI_n ***6. LBB Protection Settings:*** ***Current setting range*** ***0.1 to 2 X In (in steps of 0.1A)*** ***Time delay*** ***0.1 to 2 s (in steps of 0.02s)*** ***C. Other Features:*** ***1. Binary inputs:*** ***(i) Min 6 nos. and suitable for station aux DC.*** ***(ii) Programmable at site as per requirement*** ***(iii) Threshold voltage: > 60 % Aux. DC Supply*** ***2. Outputs:*** ***(i) Trip contacts: Minimum 2 NO contacts with*** ***a. Continuous carry: 5A*** ***b. Make & carry for 0.5s: 30A*** ***c. Make & carry for 3.0s: 15A*** ***(ii) Signaling contact:*** ***a. Minimum 6 Nos. and suitable for station aux.*** ***b. DC Programmable at site as per requirement*** ***3. Communication:*** ***a. Front Port – RS232 / RJ45 / USB*** ***b. Rear Port – RS 485/Fiber optic / Electrical Ethernet*** ***c. Protocol – IEC 60870-5-103/IEC 61850*** ***4. Housing*** ***a. Flush Mounting*** ***b. Screw Terminals ('O' Lug for CT Connection)*** ***c. Degree of Protection IP54*** ***5. Temperature and humidity*** ***Ambient temp*** ***-10 to 55 ºC*** ***Relative humidity*** ***10% to 90% Non-condensing*** ***Operate range*** ***0 – 95%*** ***Storage temp.*** ***-40 to 70 ºC***
4	**Unbalance Current Protection Relay**	**(A) Features:** It shall 1) be Single pole OR two pole type (in case of controlling 2 Banks), as specified in 'Schedule A' 2) be of numerical type 3) True Fundamental Frequency Measurement. 4) be two Stage / pole so that alarm & tripping can be set at different values of current 5) have alarm and trip output contacts. 6) Have a local Human Machine Interface (HMI) comprising of 2-3 line alphanumeric LED/ LCD readable display and a soft touch key pad to access to settings, events and records.

		7) Include hand reset, programmable as per site requirement, Flag/LED indicators (Min. 04 nos.) for identification of all Alarms and Protection operated. 8) be high speed with typical operating time of less than 25 ms. 9) be provided with 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 whenever needed. 10) Shall be able to store at least last 3 events with fault data viz. Fault current with time stamp of 1ms resolution 11) have continuous self hardware & software monitoring and diagnostic feature. **(B) Technical Parameters:** 1. Analogue Inputs: (i) Rated Current: 1A, 50 Hz, ±2.5 Hz (ii) Rated Burden: < 0.2VA (iii) Over load capability: 3xIn continuous 100xIn 1 Sec. 250xIn Dynamic 2. Auxiliary Supply: 110/220 V DC ±15 % (i) Power consumption: < 15W (ii) Ripple (peak to peak): < 12% **(C) Relay settings:** 1. Current Setting (Alarm): 10% - 50% (In steps of 5%) 2. Current Setting (Tripping): 10% - 50% (In steps of 5%) 3.Time delay : 0.04 to 2 sec (in steps of 0.01 sec) (It is inclusive of output contact operating time) 4. Pick up: Within 1.1 times of set current value. 5. Operating Time: < 25 ms. **(D) Other Features:** **1. Binary inputs :** (i) Min 5 nos. and suitable for station Aux. DC Supply (ii) Programmable at site as per requirement (iii) Threshold voltage: > 60 % Aux. DC Supply **2. Outputs:** (i) Trip contacts : Minimum 2 N/O contacts with (a) Continuous Carrying Current - 5 A (b) Make & Carry for 0.5 Sec - 20 A (c) Make & Carry for 0.2 Sec - 30 A

		(ii) Signaling contacts : (a) Minimum 4 Nos. and suitable for Station Aux. DC Supply (b) Programmable at site as per requirement **3. Communication**: • Front Port - RS232 / USB / RJ45 • Rear Port - RS485 • Protocol - IEC-60870-5-103 **4. Housing** • Flush Mounting • Screw Terminals ('O' Lug for CT Connection) • Degree of Protection IP51 **5. Temperature and humidity** (a) Ambient temp: -10 to 55 ^{o} C (b) Relative humidity: 10% to 90% Non Condensing (c) Operate range: 0-95% (d) Storage temp: -40 to 70 ^{o} C
5	**Over Voltage Protection Relay**	It shall 1) be electromagnetic/static type 2) work on Auxiliary Supply voltage of 110 / 220 V DC. 3) monitor all the three phases 4) have adjustable voltage setting range of 100 – 150% of rated voltage of 63.5 V Ph to E / 110 V Ph to Ph. 5) have inbuilt timer with adjustable time setting range of 0 to 10 seconds continuously or in step of 1 Sec. 6) have independent alarm & trip out put contacts. 7) have drop off to pick up ratio equal to or greater than 95%. 8) be provided with Hand reset flag/LED type operation indicator. 9) have minimum Three NO type potential free self reset contacts.
6	**Under Voltage Protection Relay**	The Relay shall 1) be electromagnetic/static type 2) work on Auxiliary Supply voltage of 110 / 220 V DC. 3) monitor all the three phases. 4) have adjustable voltage setting range of 40 – 90% of rated voltage of 63.5 V Ph to E / 110 V Ph to Ph. 5) have inbuilt timer with adjustable time setting range of 0 to 10 seconds continuously or in step of 1 Sec. 6) be provided with Hand reset flag/LED type operation indicator. 7) have minimum Three NC type potential free self reset contacts
7	**Power Factor Controller Relay**	The Relay shall 1) be Numerical type 2) work on Auxiliary Supply voltage of 110 / 220 V DC.

		3) have measurement of one phase i. e. it shall have one CT(1A) input and one VT (110V) Input. 4) have adjustable power factor setting range of 0.7 inductive to 0.7 capacitive. 5) have inbuilt timer with adjustable time setting range of 0 to 10 Mins continuously or in step of 1 Min. 6) Have a local Human Machine Interface (HMI) comprising of 2-3 line alphanumeric LED/ LCD readable display and a soft touch key pad to access to measurement, settings, events and records. 7) be provided with Hand reset flag/LED type operation indicator. 8) have minimum Four NO and Two NC type potential free self reset contacts of its own or through Contact Multiplication Relays replicating the contacts the relay.
8	**Auxiliary Relays for Transformer Troubles**	1) Buchholz trip - 1 No. 2) Buchholz alarm - 1 No. 3) OLTC Buchholz trip - 1 No. 4) Oil temperature trip - 1 No. 5) Oil temperature alarm - 1 No. 6) Winding temperature trip - 1 No. 7) Winding temperature alarm - 1 No 8) P.R.V. trip = 2 No. 9) Low oil level alarm - 1 No. 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. The relay shall have clear visible indication flag/LED.
9	**High Speed Trip Relay**	As per the system design sufficient relays having potential free contacts for trip circuit 1 & 2 of main / coupler breaker shall be provided. The relay shall 1) have Heavy Duty Contacts for trip circuit. 2) provide sufficient number of potential free contacts to cater the needs of connection to alarm annunciation, Optional trip facility to be connected by Purchaser where needed. 3) be instantaneous with inherent operating time less than 10 ms. It shall have 8 NO & 2NC hand resetting type contacts. It shall be 220/110V DC operating and preferably provided with single coil. 4) be provided with operation indicators**.**
10	**Trip Circuit Supervision Relay**	Trip circuit supervision relay shall be provided for each trip coil of the breaker. The relay shall 1) monitor the complete trip circuit with circuit breaker in pre-close & post-close condition. 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 meet the scheme & future requirement.

11	**PT Selection Relay**	The necessary PT selection relay shall be provided for bus voltage selection. It shall be provided with sufficient contacts for selected PT to protection and metering circuits and DC permissive to protection. The relay should be latched type with operating and resetting coils. The relay shall have clear visible indication flag/LED.
12	**Line Interface Unit**	***Area Network type: LAN capable*** ***No Of Ports: As per system requirement (Minimum 6 Ports)*** ***Ports/Interfaces: Tx & Rx fiber*** ***Features: Full duplex*** ***Suitable for entry of 2 fiber armored FO cable***

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 Protection Relays offered in the broad categories listed below:

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)	**Differential Protection Relay**	To be filled - in **by Bidder**
1	Make	
2	Type / designation	
3	Analogue Inputs	
	(i) Rated Current (Amp)	
	(ii) Rated Burden (VA)	
	(a) For 1 Amp	
	(b) For 5 Amp	
	(iii) Over load capability (X In)	
	(a) Continuous	
	(b) 1 Sec	
	(c) Dynamic	
4	Auxiliary Supply	
	(i) DC Supply Voltage (Volts)	
	(ii) Power consumption (Watts)	
	(iii) Ripple (peak to peak) (%)	
	Relay Settings	
5	Differential Protection	
	(i) Diff. Current (% In)	
	(ii) High Set Diff. Current (X In)	
	(iii) Bias Diff Current (% In)	
	(iv) 2^{nd} Harmonic Restraint (%)	
	(v) 5^{th} Harmonic Restraint (%)	
6	REF Protection	
	(i) Current range (Amp)	
	(ii) Voltage limiting non-linear resistor	
	(a) Make	
	(b) Type	
	(c) Protection Voltage, Vpk (kV)	

	(d) Max Voltage Setting (Volts)	
	(e) Leakage Current at Max. Voltage Setting	
	(iii) Stabilizing resistor	
	(a) Make	
	(b) Type	
	(c) Rating (Ohm, Watts)	
7	LBB Protection	
	(i) Current range (X In)	
	(ii) Time delay	
	(a) Range (Sec)	
	(b) Steps (Sec)	
8	Pick up value (X In)	
9	Reset current (X In)	
10	**Binary Inputs**	
	(i) Nos. of Inputs	
	(ii) Threshold voltage (Volts)	
	(iii) Whether programmable at site as per	
11	**Output Contacts**	
	(i) Nos. of Tripping Contacts	
	(ii) Tripping Contacts Rating	
	(a) Continuous Carrying Current (Amp)	
	(b) Make & Carry for 0.5 sec (Amp)	
	(c) Make & Carry for 3.0 sec (Amp)	
	(iii) Nos. of Signaling Contacts	
	(iv) Whether programmable at site as per	
	General points and Features	
12	Operating principle	
13	Number of CT inputs	
14	Whether internal phase angle and ratio correction is available.	
15	Whether adjustable slope characteristics available	
16	Whether continuous self-monitoring and diagnostic feature is available	
17	Operating time at 5 times the set current	
	Operating time settings for High Set Differential Protection (Range is Sec and Steps in Sec)	
18	Availability of DR & SER with Date & Time stamping	
19	Disturbance Records (DR) Storage Capability	
	(i) Nos.	
	(ii) Duration of each DR (Sec)	
20	Local Computer Communication :	

	(i) Protocol	
	(ii) Front Port	
	(iii) Rear port	
21	Mounting Type	
22	Terminals	
23	Enclosure Ingress Protection	
24	Temperature and Humidity	
25	SCADA compatibility, if available	
26	Software	
	(i) Name & designation	
	(ii) Validity	
	(iii) No. of copies	
	(iv) Language (English)	
(B)	**Directional O/C & E/F Protection Relay**	
1	Make	
2	Type / designation	
3	Analogue Inputs	
	(i) Rated Current (Amp)	
	(ii) Rated Burden (VA)	
	(a) For 1 Amp	
	(b) For 5 Amp	
	(iii) Over load capability (X In)	
	(a) Continuous	
	(b) 1 Sec	
	(c) Dynamic	
4	Auxiliary Supply	
	(i) DC Supply Voltage (Volts)	
	(ii) Power consumption (Watts)	
	(iii) Ripple (peak to peak) (%)	
	Relay Settings	
5	Directional Over Current Protection	
	(i) Current Range (% In)	
	(ii) Current Steps (%)	
6	Direction Earth Fault Protection	
	(i) Current Range (% In)	
	(ii) Current Steps (%)	
7	High Set Directional Over Current Protection	
	(i) Current Range (% In)	
	(ii) Current Steps (%)	
8	High Set Directional Earth Fault Protection	
	(i) Current Range (% In)	
	(ii) Current Steps (%)	
9	Time multiplier for IDMT characteristics	
	(i) Time Multiplier Range	
	(ii) Steps	
10	Definite Time delay for all protection	

	(i) Time Delay Range (Sec)	
	(ii) Steps (Sec)	
11	Time delay for high set elements	
	(i) Time Delay Range (Sec)	
	(ii) Steps (Sec)	
12	Whether all Time Multiplier and Time Delay Settings are independent for O/C and E/F	
13	LBB Protection	
	(i) Current Setting (X In)	
	(ii) Time delay	
	(a) Range (Sec)	
	(b) Steps (Sec)	
14	Pick up value (X In)	
15	Reset current (X In)	
16	**Binary Inputs**	
	(i) Nos. of Inputs	
	(ii) Threshold voltage (Volts)	
	(iii) Whether programmable at site as per requirement	
17	**Output Contacts**	
	(i) Nos. of Tripping Contacts	
	(ii) Tripping Contacts Rating	
	(a) Continuous Carrying Current (Amp)	
	(b) Make & Carry for 0.5 sec (Amp)	
	(c) Make & Carry for 3.0 sec (Amp)	
	(iii) Nos. of Signaling Contacts	
	(iv) Whether programmable at site as per requirement	
	General points and Features	
18	Number of CT inputs	
19	Number of VT Inputs	
20	Whether decides directionality through zero sequence quantity, derived internally.	
21	Whether In-built VT supervision feature available	
22	Whether continuous self-monitoring and diagnostic feature is available	
23	Operating time for instantaneous element (milliseconds)	
24	Nos. of LED indications	
25	Nos. of events with fault data and date & time stamping	
26	Disturbance Records (DR) - Total time duration (Sec)	
27	Local Computer Communication :	
	(i) Protocol	
	(ii) Front Port	
	(iii) Rear port	
28	Mounting Type	
29	Terminals	
30	Enclosure Ingress Protection	
31	Temperature and Humidity	

32	SCADA compatibility, if available	
33	Software	
	(i) Name & designation	
	(ii) Validity	
	(iii) No. of copies	
	(iv) Language (English)	
(C)	**<u>Non-Directional O/C & E/F Protection Relay</u>**	
1	Make	
2	Type / designation	
3	Analogue Inputs	
	(i) Rated Current (Amp)	
	(ii) Rated Burden (VA)	
	(a) For 1 Amp	
	(b) For 5 Amp	
	(iii) Over load capability (X In)	
	(a) Continuous	
	(b) 1 Sec	
	(c) Dynamic	
4	Auxiliary Supply	
	(i) DC Supply Voltage (Volts)	
	(ii) Power consumption (Watts)	
	(iii) Ripple (peak to peak) (%)	
	Relay Settings	
5	Over Current Protection	
	(i) Current Range (% In)	
	(ii) Current Steps (%)	
6	Earth Fault Protection	
	(i) Current Range (% In)	
	(ii) Current Steps (%)	
7	High Set Over Current Protection	
	(i) Current Range (% In)	
	(ii) Current Steps (%)	
8	High Set Earth Fault Protection	
	(i) Current Range (% In)	
	(ii) Current Steps (%)	
9	Time multiplier for IDMT characteristics	
	(i) Time Multiplier Range	
	(ii) Steps	
10	Definite Time delay for all protection	
	(i) Time Delay Range (Sec)	
	(ii) Steps (Sec)	
11	Time delay for high set element	
	(i) Time Delay Range (Sec)	
	(ii) Steps (Sec)	
12	Whether all Time Multiplier and Time Delay Settings are independent for O/C and E/F	
13	LBB Protection Settings	

	(i) Current Setting (X In)	
	(ii) Time delay	
	(a) Range (Sec)	
	(b) Steps (Sec)	
14	Pick up value (X In)	
15	Reset current (X In)	
16	**Binary Inputs**	
	(i) Nos. of Inputs	
	(ii) Threshold voltage (Volts)	
	(iii) Whether programmable at site as per requirement	
17	**Output Contacts**	
	(i) Nos. of Tripping Contacts	
	(ii) Tripping Contacts Rating	
	(a) Continuous Carrying Current (Amp)	
	(b) Make & Carry for 0.5 sec (Amp)	
	(c) Make & Carry for 3.0 sec (Amp)	
	(iii) Nos. of Signaling Contacts	
	(iv) Whether programmable at site as per requirement	
	General points and Features	
18	Number of CT inputs	
19	Whether continuous self-monitoring and diagnostic feature is available	
20	Operating time for instantaneous element (milliseconds)	
21	Nos. of LED indications	
22	Nos. of events with fault data and date & time stamping	
23	Disturbance Records (DR) - Total time duration (Sec)	
24	Local Computer Communication :	
	(i) Protocol	
	(ii) Front Port	
	(iii) Rear port	
25	Mounting Type	
26	Terminals	
27	Enclosure Ingress Protection	
28	Temperature and Humidity	
29	SCADA compatibility, if available	
30	Software	
	(i) Name & designation	
	(ii) Validity	
	(iii) No. of copies	
	(iv) Language (English)	
(D)	**Unbalance Current Protection Relay**	
1	Make	
2	Type / designation	
3	Analogue Inputs	
	(i) Rated Current (Amp)	
	(ii) Rated Burden (VA)	

	(iii) Over load capability (X In)	
	(a) Continuous	
	(b) 1 Sec	
	(c) Dynamic	
4	Auxiliary Supply	
	(i) DC Supply Voltage (Volts)	
	(ii) Power consumption (Watts)	
	(iii) Ripple (peak to peak) (%)	
	Relay Settings	
5	Current Settings for Alarm Stage	
	(i) Current Range (% In)	
	(ii) Current Steps (%)	
6	Current Settings for Tripping Stage	
	(i) Current Range (% In)	
	(ii) Current Steps (%)	
7	High Set Over Current Protection	
	(i) Current Range (% In)	
	(ii) Current Steps (%)	
8	Time multiplier for IDMT characteristics	
	(i) Time Multiplier Range	
	(ii) Steps	
9	Definite Time delay for all protection	
	(i) Time Delay Range (Sec)	
	(ii) Steps (Sec)	
10	Time delay for high set element	
	(i) Time Delay Range (Sec)	
	(ii) Steps (Sec)	
11	Pick up value (X In)	
12	Reset current (X In)	
13	**Binary Inputs**	
	(i) Nos. of Inputs	
	(ii) Threshold voltage (Volts)	
	(iii) Whether programmable at site as per requirement	
14	**Output Contacts**	
	(i) Nos. of Tripping Contacts	
	(ii) Tripping Contacts Rating	
	(a) Continuous Carrying Current (Amp)	
	(b) Make & Carry for 0.5 sec (Amp)	
	(c) Make & Carry for 3.0 sec (Amp)	
	(iii) Nos. of Signaling Contacts	
	(iv) Whether programmable at site as per requirement	
	General points and Features	
15	Number of CT inputs	
16	Whether Single Pole or Two Pole	
17	Nos. of Stages / Pole	
18	Operating time (milliseconds)	

19	Nos. of LED indications	
20	Nos. of events with fault data and date & time stamping	
21	Local Computer Communication :	
	(i) Protocol	
	(ii) Front Port	
	(iii) Rear port	
22	Mounting Type	
23	Terminals	
24	Enclosure Ingress Protection	
25	Temperature and Humidity	
26	SCADA compatibility, if available	
27	Software	
	(i) Name & designation	
	(ii) Validity	
	(iii) No. of copies	
	(iv) Language (English)	
(E)	**Over Voltage Protection Relay**	
1	Make	
2	Type / designation	
3	Analogue Inputs	
	(i) Rated Voltage (Volt)	
	(ii) Rated Burden (VA)	
4	Auxiliary Supply	
	(i) DC Supply Voltage (Volts)	
	(ii) Power consumption (Watts)	
5	Voltage Settings for Alarm	
	(i) Voltage Range (% Vn)	
	(ii) Voltage Steps (%)	
6	Voltage Settings for Tripping	
	(i) Voltage Range (% Vn)	
	(ii) Voltage Steps (%)	
7	Inbuilt Timer	
	(i) Time Delay Range (Sec)	
	(ii) Steps (Sec)	
8	Nos. of Poles	
9	Whether monitors all the three phases	
10	Output Contacts – Independent for Alarm & Tripping	
11	Nos. of Auxiliary Output Contacts	
12	Drop off to Pick up ratio	
(F)	**Under Voltage Protection Relay**	
1	Make	
2	Type / designation	
3	Analogue Inputs	
	(i) Rated Voltage (Volt)	
	(ii) Rated Burden (VA)	
4	Auxiliary Supply	
	(i) DC Supply Voltage (Volts)	
	(ii) Power consumption (Watts)	

5	Voltage Settings for Alarm	
	(i) Voltage Range (% Vn)	
	(ii) Voltage Steps (%)	
6	Voltage Settings for Tripping	
	(i) Voltage Range (% Vn)	
	(ii) Voltage Steps (%)	
7	Inbuilt Timer	
	(i) Time Delay Range (Sec)	
	(ii) Steps (Sec)	
8	Nos. of Poles	
9	Whether monitors all the three phases	
10	Output Contacts – Independent for Alarm & Tripping	
11	Nos. of Auxiliary Output Contacts	
(G)	**Power Factor Controller Relay**	
1	Make	
2	Type / designation	
3	Analogue Inputs	
	(i) Rated Voltage (Volt)	
	(ii) Rated Current (Amp)	
	(iii) Rated Burden (VA)	
4	Auxiliary Supply	
	(i) DC Supply Voltage (Volts)	
	(ii) Power consumption (Watts)	
5	Power Factor Setting	
	(i) Power Factor Range	
	(ii) Steps	
6	Inbuilt Timer	
	(i) Time Delay Range (Sec)	
	(ii) Steps (Sec)	
7	No. of Output Contacts	
	(i) NO Contacts	
	(ii) NC Contacts	
(H)	**Auxiliary Relays for Transformer Troubles**	
1	Make	
2	Type / designation	
3	Auxiliary Supply	
	(i) DC Supply Voltage (Volts)	
	(ii) Power consumption (Watts)	
4	Nos. of Output Contacts	
5	Operation Indicator – Whether Flag or LED	
(I)	**High Speed Trip Relay**	
1	Make	
2	Type / designation	
3	Auxiliary Supply	
	(i) DC Supply Voltage (Volts)	
	(ii) Power consumption (Watts)	
4	Nos. of Output Contacts	

	(i) NO Contacts	
	(ii) NC Contacts	
5	Output Contacts Rating	
	(a) Continuous Carrying Current (Amp)	
	(b) Make & Carry for 0.5 sec (Amp)	
	(c) Make & Carry for 3.0 sec (Amp)	
6	Relay Operating Time (ms)	
7	Operation Indicator – Whether Flag or LED	
(J)	**Trip Circuit Supervision Relay**	
1	Make	
2	Type / designation	
3	Auxiliary Supply	
	(i) DC Supply Voltage (Volts)	
	(ii) Power consumption (Watts)	
4	Nos. of Output Contacts	
5	Operation Indicator – Whether Flag or LED	
6	Whether provides Pre-Close and Post-Close supervision	
7	Delay on Drop-off (ms)	
(K)	**PT Selection Relay**	
1	Make	
2	Type / designation	
3	Auxiliary Supply	
	(i) DC Supply Voltage (Volts)	
	(ii) Power consumption (Watts)	
4	Nos. of Output Contacts	
5	Operation Indicator – Whether Flag or LED	
6	Whether latched type with operating and resetting coils	
(L)	***Line Differential Protection***	
	Features:	
1	***Shall be Numerical type***	
2	***TRUE RMS Measurement.***	
3	***Self-monitoring feature.***	
4	***Working Principle***	
5	***Slope Characteristics***	
6	***Display & Measurement of Differential as well as Restrain current***	
7	***Shall communicate analogue as well as digital signals to remote end.***	
8	***Communication options (multimode / single mode for direct communication or multi-mode communication through multiplexer)***	
9	***Shall support communication through IEEE C37.94 format in case of communication though multiplexer.***	
10	***No. of communication channel (single/dual)***	
11	***Communicate time coordinated current signals for remote communication to execute Line differential***	

	protection algorithm accurately. Time synchronization through GPS / Echo (internal sync. Method).	
12	***Line charging current compensation feature***	
13	***In built Dir O/C-E/F protection feature.***	
14	***Dir. O/C & E/F and Differential Protection function selection (Independent or Backup in case of remote communication failure)***	
15	***Shall have 3 (Three) over current and 1 (One) Earth Fault element.***	
16	***Supervision for communication link and able to generate alarm.***	
17	***Have selectable and front panel programmable normal inverse, very inverse, extremely inverse & long inverse IEC/ANSI Characteristic.***	
18	***Selectable CT Secondary. I.e. 1A/5A***	
19	***High set Over current with selectable time delay.***	
20	***High set Earth fault with selectable time delay***	
21	***Have adjustable characteristic angle, lead / lag, for Directional over current/ Earth Fault respectively.***	
22	***Shall decide directionality by internally derived zero sequence quantity through software.***	
23	***Shall have in built Breaker Failure Protection.***	
24	***Shall have in built VT supervision feature.***	
25	***Include hand reset Flag/LED indicators for fault.***	
26	***Readable Human Machine Interface with LCD display.***	
27	***Should be able to store at least last 3 fault records viz. Fault current, Faulty Phase etc. with time stamp.***	
28	***Shall have Disturbance Recording facility for minimum 3 sec for each fault.***	
29	***Self-monitoring.***	
30	***Relay offered shall be communicable type.***	
31	***Be supplied along with all suitable Original Customized licensed software & communication cable for local and remote communications, analysis of fault etc.***	
	Technical Parameters:	
1	***Analogue input:*** ***a) Rated Current*** ***b) Rated Burden*** ***c) Over Load Capabilities*** ***d) Rated Voltage*** ***e) Rated Burden*** ***f) Over Voltage Capabilities***	
2	***Power:*** ***a) Auxiliary Supply*** ***b) Power Consumption***	

	c) Ripple (peak to peak)	
3	***Line Differential Protection Settings:*** ***a) Minimum operating current*** ***b) Slope Characteristics (Single / Dual)*** ***c) End section (single / dual)*** ***d) Highset operating current*** ***e) 2nd Harmonic Blocking*** ***f) Typical operating time*** - ***Normal Diff. operating time*** - ***Highset Diff. operating time*** ***g) Synchronization mode (GPS / Echo (internal sync. method)***	
4	***Remote Communication:*** ***a) No. of Analogue signal transfer*** ***b) No. of Binary signal transfer*** ***c) Remote communication module*** ***d) Max. Distance supported***	
5	***Dir O/C – E/F protection settings:*** ***a) Over Current*** ***b) Earth Fault*** ***c) High set O/C*** ***d) High set E/F*** ***e) Time multiplier for IDMT for O/C-E/F*** ***f) Time delay for highset element*** ***g) Pick up*** ***h) Reset current*** ***i) Operating Time*** ***j) MTA characteristics angle range*** ***a. For O/C*** ***b. For E/F***	
6	***LBB protection settings:*** ***a) Current setting range*** ***b) Time delay***	
	Other Features: ***2. Binary inputs:*** ***a. No. of binary inputs*** ***b. Is it programmable?*** ***3. Binary Outputs:*** ***a. No. of Tripping contacts*** ***b. Rating of tripping contacts*** ***i. Continuous current carrying capacity (A)*** ***ii. Make & carry for 0.5 s (A)*** ***iii. Make & carry for 3.0 s (A)*** ***c. No. of signaling contacts*** ***d. Whether programmable at site as per requirement.*** ***4. Communication:***	

	a. Front port ***b. Rear port*** ***c. Communication protocol*** ***5. Housing type*** ***6. Terminals*** ***7. Enclosure ingress protection*** ***8. Temperature and humidity:*** ***a. Ambient temp.*** ***b. Relative humidity*** ***c. Operating range*** ***d. Storage temp.***	
(M)	***Line Interface unit*** ***1. Make*** ***2. Type*** ***3. No. of FO cable*** ***4. No. of connector ports*** ***5. Mounting*** ***6. Size*** ***7. Metal box material***	