Specification No: ENG-LV-0040 (R1)

Specification Name:

Technical Specification for 33 & 11kV Control and Relay Panel (Indoor/Outdoor Application)

CONTENTS

1. SCOPE

The scope of this specification covers the technical requirements for design, manufacture, testing at the manufacturer's works, packing, forwarding, supply, unloading at site/stores, installation, testing, and commissioning of Control & Relay Panels (CRP), IEDs, protection relays and all other items, accessories and tools required for protection of the 33 kV / 11 kV power system, as detailed in this specification.

The scope also includes the supply and integration of all associated auxiliaries necessary to ensure a complete, efficient, reliable, and trouble-free protection system. The specific technical and functional requirements are detailed in the enclosed Technical Data Sheets (TDS).

The Control & Relay Panels (C&R Panels) covered under the scope of this Technical Specification include the following:

a) 11 kV Feeder Panel
b) 11 kV Incomer (I/C) Panel
c) 11 kV Bus Coupler (B/C) Panel
d) 33 kV Feeder Panel
e) 33/11 kV Transformer Panel
f) 11 kV Capacitor Panel

C&R Panels may be designed for Indoor or Outdoor application as per tender requirement.

2. APPLICABLE STANDARDS

The equipment covered by this specification shall, unless otherwise stated, be designed, manufactured, constructed and tested in accordance with the latest revisions of relevant Indian, IEC and other applicable international standards and shall conform to the rules and regulations of local statutory authorities.

The applicable standards include, but are not limited to, the following:

- **IS 9000** – Basic environmental testing procedures for electrical and electronic equipment
- **IS 3231 (Part 3, Section 1)** – Specification for Electrical Relays for Power System Protection: Requirements for non-specified time or independent specified time measuring relays
- **IS 3231 (Part 3, Section 2)** – Specification for Electrical Relays for Power System Protection: Requirements for dependent specified time measuring relays
- **IS 3231 (Part 3, Section 3)** – Specification for Electrical Relays for Power System Protection: Requirements for biased (percentage) differential relays
- **IEC 60255** – Measuring relays and protection equipment
- **IS 694:1990** – PVC-insulated cables for working voltages up to and including 1,100 V
- **IEC 60529** – Degrees of protection provided by enclosures (IP Code)
- **IEC 62052-11** – Electricity metering equipment (AC): General requirements, tests, and test conditions
- **IEC 62053-22** – Static meters for active energy (Accuracy Class 0.2S and 0.5S)
- **IEC 61850 (all parts)** – Communication networks and systems for power utility automation, including:

- IEC 61850-8-1
- IEC 61850-9-2
- IEC 61850-8-2 (peer-to-peer communication)

- **IEC 60870-5-103** – Communication protocol for protection equipment
- **IEC 61869-9** – Digital interface for instrument transformers
- **IEC 61869-13** – Stand-alone merging units
- **IEC 61588 / IEEE 1588v2** – Precision Time Protocol (PTP) for clock synchronization in networked measurement and control systems
- **IEC 62351** – Power systems management and associated information exchange: Data and communications security
- **IS 2633:1986** – Methods of testing for uniformity of zinc coating

3. CLIMATIC CONDITIONS OF THE INSTALLATION:

1	Maximum ambient temperature	50 deg C
2	Max. Daily average ambient temp	35 deg C
3	Min Ambient Temperature	0 deg C
4	Maximum Humidity	95%
5	Average Annual Rainfall	150cm
6	Average No. of rainy days per annum	120
7	Altitude above MSL not exceeding	1000m
8	Wind Pressure	200 Km/hr
9	Earthquakes of an intensity in horizontal direction	equivalent to seismic acceleration of 0.3g
10	Earthquakes of an intensity in vertical direction	equivalent to seismic acceleration of 0.15g (g being acceleration due to gravity)

TPCODL/TPNODL/TPSODL/TPWODL service area has heavy saline conditions along the coast and High cyclonic Intensity winds with speed upto 200 Kmph. The atmosphere is generally laden with mild acid and dust in suspension during the dry months and is subjected to fog in cold months.

4. GENERAL TECHNICAL REQUIREMENTS

a) All offered devices shall be IEC 61850 Level-A certified by KEMA / DNVGL.
b) The numerical protection relays shall support IEC 61850 Edition-1 and Edition-2, including site-selectable minimum RSTP.
c) The relay manufacturer shall have a minimum of 10 years' experience in the design, development, and implementation of IEC 61850-based IEDs.

d) The supplier/manufacturer shall have at least 10 years' experience in design, development, and supply of control and protection systems for electricity transmission and distribution, including in-house development of both hardware and software for IEC 61850-based IEDs.
e) The manufacturer whose protection system is offered shall have designed, manufactured, tested, installed and commissioned similar systems for electricity transmission and distribution for a period of not less than five (5) years.
f) The manufacturer shall submit documentary evidence / experience certificates from utilities or equivalent organizations to substantiate the above experience.
g) All offered devices shall be conformal-coated using an automatic conformal coating process, in accordance with globally accepted conformal coating standards, suitable for harsh substation environments.
h) The Business Associate (BA) may propose an innovative or advanced system. Such proposals shall be subject to approval by TPCODL / TPNODL / TPSODL / TPWODL after detailed technical discussions.
In case approval is not granted, the existing / desired infrastructure of the DISCOMs shall prevail, and the BA shall supply the system accordingly.
i) The BA shall optimize the cost of software licenses by considering the existing licenses already available with TPCODL / TPNODL / TPSODL / TPWODL. The software licensing policy for all offered tools shall be clearly stated in the offer.
j) The BA shall provide training to personnel nominated by TPCODL / TPNODL / TPSODL / TPWODL for system operation, maintenance, and troubleshooting. Minimum training duration: three (3) days.
k) The BA shall provide MIB files for all Numerical Protection IEDs, Merging Units, and GPS / Time Synchronization devices to enable integration of SNMP traps with the Network Management System (NMS).
l) The relay manufacturer shall submit a Cyber Security Conformance Statement for the offered devices or device series, in line with applicable standards (such as IEC 62351).

4.2 General System Design

Protection and Control Intelligent Electronic Devices (IEDs) shall respond to measured current and voltage signals at defined points of the power system and assess the condition of the protected power system components. The system shall be suitable for operation and monitoring of the complete substation, including future extensions, and shall operate fully in accordance with IEC 61850.

Conventionally, analog values are injected directly into the IED through instrument transformers. The IED shall combine analog-to-digital conversion, digital signal processing (filtering), and protection decision-making algorithms within the device.

The IEC 61850 standard enables digital exchange of data between Merging Units (MUs) and protection devices. Merging Units, being integral components of a digital substation, shall continuously digitize analog signals and transmit them to the process bus as data packets, ensuring proper labeling and data integrity during transmission. The process bus shall represent a communication network interconnecting data publishers and subscribers. Protection and control IEDs shall receive these digital packets and process current and voltage information. Transfer of instantaneous current and voltage values is required for the full range of protection and control functions. Devices connected to the process bus shall therefore register

electrical phenomena as sampled signals in the same manner as if analog-to-digital conversion were performed internally within the relay. Digital communication shall be implemented through redundant RJ45 Ethernet ports.

As per IEC 61850-9-2 LE, each transmitted packet shall include one sample of three-phase currents, three-phase voltages, and residual current, and neutral voltage. Most filtering algorithms rely on an equal time distribution of samples and are highly sensitive to sample loss. Under such conditions, the relay shall take appropriate corrective actions, such as computing missing samples.

Packet delivery time drift may lead to irregular data flow to the protection equipment. To manage packet delays in the communication channel and maintain the required regularity of data processing, a sample buffer shall be implemented. The buffer time shall accommodate the maximum anticipated communication delay without affecting the overall relay tripping time.

All sampled values shall be synchronously time-stamped using Precision Time Protocol (PTP). If synchronization is lost, the collected samples cannot be correctly aligned; consequently, the related relay functions shall be blocked, and an alarm shall be indicated to maintenance personnel via the Station Bus to the RTU/DC and the Integrated Network Management System (NMS).

Loss of communication with a Merging Unit on the process bus shall have an impact equivalent to loss of current or voltage secondary circuits. Such a condition shall be detected when packet delay exceeds a preset threshold, enabling timely relay operation. Protection functions dependent on the affected data source shall be blocked, and loss of connection shall be reported to maintenance personnel through the Station Bus to the RTU/DC and NMS.

Merging Units shall continuously perform self-diagnostics. In the event of an internal failure, sampled values shall be marked with a poor-quality attribute as defined in IEC 61850. If poor-quality samples are received, dependent protection and control functions shall be blocked, and failure information shall be communicated to maintenance personnel via the Station Bus to the RTU/DC and NMS.

Role-based login privileges shall be provided, with separate access levels for the Protection Team and Automation Team, applicable to all Protection IEDs and Merging Units.

Protection and control IEDs shall be of internally modular design. Internal modularity implies that all functional cards are housed entirely within the relay enclosure, with no external exposure. It also requires that no external I/O devices be connected via fiber, cable, or bus arrangements; all modules shall be integral to the main device through pin-to-pin connections. No separate configuration tools or proprietary inter-device communication shall be permitted. Devices shall be flush-mounted.

The draw-out design shall ensure that no cards remain within the casing when removal is initiated and CT terminals shall be automatically short-circuited during the draw-out process. The thermal design shall prevent intrusion by insects or small organisms. Where inherent design is insufficient, the OEM shall provide additional protective measures.

All **printed circuit boards (PCBs**) shall be **conformal coated** with harsh environmental coating compliant with IEC 60068 (HEC) to enhance particle repellence and service life. Test reports shall be submitted. The IEDs shall be manufactured using lead-free components.

The enclosure protection shall be IP54 at the front and IP20 at the rear. All wiring shall terminate at the rear of the relay with sufficient spacing to facilitate ease of wiring, inspection and testing**. All terminals shall be** ring type **and no terminals shall be vertically aligned when viewed from the rear.**

Equipment shall be designed for a minimum service life of fifteen (15) years under specified environmental and application conditions. While routine and breakdown maintenance is expected, the bidder shall declare the expected replacement frequency and life expectancy of any consumable components or modules.

The IED/relay shall provide protection functions with freely settable operating magnitudes and a minimum time delay of 20 ms. A minimum of four (4) setting groups shall be supported.

Fascia Requirements

The IED fascia shall incorporate a clear and bright LCD display, readable from a distance of at least one meter, capable of displaying the Single Line Diagram (SLD) of the respective bay along with the following information:

1. Bay name
2. Running date and time
3. CT ratio
4. Three-phase currents
5. Three-phase voltages (phase-to-phase)

The display shall provide a minimum of four pages, including positive, negative and zero-sequence values of current and voltage, as well as additional parameters such as Total Harmonic Distortion (THD). A tactile keypad or navigation keys shall be provided for menu navigation and relay setting.

The fascia shall include at least ten (10) user-configurable LEDs for annunciation. LED labels shall not be permanent and shall be provided via replaceable LED strips, either printed or software-configurable. A green LED shall indicate healthy device operation.

Dedicated Open and Close pushbuttons shall be provided for control of circuit breakers or other field devices. A minimum of five (5) configurable control switches, including the circuit breaker, shall be supported.

A front-mounted communication port shall be provided for local access. A reset function shall be available to clear all LEDs and reset all outputs simultaneously, either through a dedicated reset button or a configurable key.

Inputs & Outputs

Auxiliary Power Supply

The auxiliary power supply input shall be suitable for operation on both 24 V DC and 48 V DC. The auxiliary input circuit shall be provided with an in-built surge protection device within the relay to ensure that external DC surges or accidental high AC voltages do not damage sensitive PCB components.

Analog Inputs (Current & Voltage)

The relay shall have four (4) analog current inputs and four (4) analog voltage inputs.

a) Current inputs shall be suitable for both 1 A and 5 A ratings. Selection of 1 A or 5 A input shall be software-selectable based on field requirements.
b) The short-time current withstand capability of current inputs shall be specified by the bidder and shall be not less than four times rated current for 1 second.
c) Analog values shall be injected into the IED through instrument transformers. The IED shall perform analog-to-digital conversion, digital filtering, and protection decision-making algorithms internally.
d) The sampling frequency shall be not less than 32 samples per cycle.
e) Adequate protective measures shall be incorporated to ensure that transients arising from CT and VT circuits due to extraneous disturbances in the HV system do not damage the numerical IEDs. CT saturation shall not cause mal-operation of any protection functions.

Voltage input circuits shall be designed such that at least one voltage channel can withstand phase-to-phase voltage, enabling use of synchronization (“SYNC”) functions where required.

Digital Inputs

a) Digital inputs shall be suitable for 24 V DC and 48 V DC operation.
b) Each digital input circuit shall have in-built surge protection, similar to the auxiliary supply circuit.
c) Inputs shall be of opto-coupler type.
d) A minimum of three (3) digital inputs shall be provided with independent positive and negative terminals (no common positive or common negative).
e) Software-configurable digital input sensing delay shall be provided, adjustable both through the configuration software and relay fascia.
f) The opto-coupler shall operate reliably at 80% of the rated voltage, i.e. for 24 V DC input, correct operation shall be ensured at 19.2 V DC.

Digital Outputs

a) Digital outputs shall be suitable for 24 V DC and 48 V DC operation.
b) Outputs shall be of potential-free contact type when not connected to any external wiring.
c) A minimum of four (4) power output contacts shall be provided for high current switching applications.
d) The current rating of power contacts shall be clearly specified by the bidder.
e) Digital outputs shall be freely programmable through both software tools and the relay fascia.
f) The device shall include a minimum of one (1) watchdog contact for relay health monitoring.

Diagnosis Capability of IED

a) Numerical Protection IEDs shall be provided with continuous self-monitoring and cyclic self-test facilities to ensure reliable operation. The internal clock of the IED shall be capable of synchronization through a GPS Time Synchronization System, which shall be provided by the Owner at a later stage.
b) The IED shall be capable of detecting and reporting internal hardware and functional abnormalities through built-in diagnostic features. The diagnosis facility may be part of the configuration software or a dedicated diagnostic tool supplied with the relay.
c) The diagnostic capability shall support forcing/simulation of all types of inputs and outputs, including:
d) Digital inputs
e) Digital outputs
f) Program-generated inputs and outputs
g) The IED shall support forcing/simulation of all protection functions for testing and validation purposes while the device is energized and in service.
h) Forcing of all LEDs on the relay fascia shall be possible for testing annunciation and indication circuits.
i) The relay shall be capable of being rebooted locally using relay keys as well as remotely through the software tool.
j) The diagnosis tool/software shall be capable of identifying failure patterns and pre-failure conditions, enabling predictive maintenance and early fault detection.
k) A comprehensive list of frequently occurring diagnostic error codes, along with their descriptions and recommended corrective or preventive actions, shall be provided by the manufacturer.

Oscillography

1. The oscillography function shall allow user-selectable triggering, enabling waveform generation for selected protection, control, or logic functions.
2. The waveform content shall be independently configurable and shall include:

    i. All current channels
    ii. All voltage channels
    iii. Digital channels (minimum 24)

3. Transformer differential relays shall record all HV and LV analog channels, including biasing current and restraint current.
4. Phasor display shall be available along with positive, negative, and zero-sequence quantities.
5. Sequence quantities shall be displayed in multiple representations, such as actual values (A, V) or as a percentage of positive-sequence values.
6. Disturbance Recorder (DR) software shall provide two or more movable cursors to clearly distinguish pre-fault, fault, and post-fault conditions.
7. The IED software shall provide transient playback facilities.
8. Oscillographic records shall capture:

    i. Any configurable protection characteristic
    ii. Any program-generated output
    iii. Any program-generated input

iv. Any digital input and digital output
v. Any GOOSE-transmitted signals
vi. Any GOOSE-received signals

9. Waveforms shall be stored even upon DC supply failure.
10. Oscillographic records shall be exportable in COMTRADE format.
11. Storage shall be FIFO-based, with a minimum recording duration of 20 seconds. Configuration shall be user-selectable, including recording window length, number of records, and triggering options.

System Events

1. The system shall support a minimum of 600 event records with a time resolution of 1 ms.
2. Events shall be readable:
3. From the relay fascia
4. Through the engineering software
5. Events related to any single state change (binary input/output, program-generated input/output, protection operation, GOOSE signals, etc.) shall be either automatic or user-configurable.
6. Event records shall be downloadable from front and rear communication ports without requiring any configuration changes.
7. All events shall be viewable directly on the relay fascia.
8. Fault records shall be stored separately from system events and shall be downloadable from both the relay fascia and the software.

Software Requirements

1. A maximum of two (2) software tools shall be used to interface with the relay, covering:

i. Device configuration and parameterization
ii. IEC 61850 system configuration
iii. Oscillography upload, download, and analysis

2. Device engineering and IEC 61850 configuration shall be possible using the same software platform.
3. The software shall provide full access to all configuration and parameterization functions available on the relay fascia.
4. The device shall support a minimum of three (3) security levels, with user-ID and password-based access control for configuration, parameterization, IEC 61850 settings, and event/oscillography retrieval.
5. Facility for software-initiated relay restart shall be provided.
6. Software-based testing facilities shall be available to allow point-to-point testing and simulation of signals while the relay remains energized and in service.
7. The relays shall comply with recognized cybersecurity standards, such as NERC CIP, BDEW, IEEE 1686, or equivalent, to protect against unauthorized access, disclosure, modification, or destruction of data.
8. A separate logic shall be implemented to maintain a breaker operation counter for fault operations only. This counter shall be non-volatile and shall not reset during device reboot or power loss.
9. When the BCPU/Protection Unit is reset from SCADA or locally, all protection indications and outputs shall reset simultaneously at both relay and SCADA level. Additional logic may be implemented to achieve this.

10. Order codes:
11. All 11 kV IEDs (BCPU & PU) shall have identical order codes across panel types to facilitate IEC 61850 project management and one-to-one replacement.
12. All 33 kV BCPUs shall also have a common order code for the same purpose.
13. The bidder shall provide all required software licenses (engineering, settings, disturbance recording, etc.) on a site-license basis, valid for the entire life cycle of the plant/equipment.
14. Antivirus licenses, where applicable, shall include regular updates.
15. The bidder shall guarantee that all software is defect-free and shall rectify any defects during the system life at no cost to the Owner.
16. All software components shall be supplied with the latest official versions available at the time of shipment, including updates released up to that date.
    A certificate confirming this shall be submitted during pre-dispatch inspection.
17. Any software revisions or patches released during the warranty period that address defects shall be implemented on site and the system re-tested at no additional cost (excluding revisions introducing new functionality).
18. The bidder shall periodically inform the Owner of software updates and new releases after commissioning and shall train Owner's engineers on upgrade procedures.

Engineering, Documentation & Miscellaneous

1. Two (2) communication cables for each relay type shall be supplied for data upload/download from front and rear ports.
2. One (1) Serial-to-USB converter shall be supplied.
3. Station project files shall be prepared and finalized prior to inspection call and submission of internal test reports.
4. The bidder shall submit two (2) copies of as-built drawings and station project files in soft copy (pen drive) format.
5. Technical keys / naming conventions (e.g. 11KVIC2, 33KVIC1, 33KVPTR2) shall follow the approved SLD and be finalized during detailed engineering.
6. Report control blocks shall be configured during initial programming. Required signals and types shall be provided during detailed engineering.
7. IP addresses, SNTP server details, and CT/PT ratios shall be provided during detailed engineering.
8. All protection and control functions shall be configured OFF by default and enabled only with approved settings finalized during detailed engineering.
9. Minimum counts:

    i. Program-generated inputs: 32
    ii. Program-generated outputs: 32
    iii. GOOSE inputs: 20
    iv. GOOSE outputs: 20

10. The IED shall be freely configurable for IEC 61850 Edition-1 and Edition-2, shall support minimum six (6) clients, and shall be compatible with third-party SCL/SCD files.
11. For both new installations and retrofit works, the presence of an OEM engineer shall be mandatory (directly or through an authorized representative)

SNMP

1. Shall be made available in each IED.
2. The IED should be communicated by remote servers through the gateway configured in the IED.
3. Web HMI should be made available in the relay so that relay can be accessed from remote from computer browser.
4. The web HMI should facilitate every possible access which can be done from relay fascia
5. In the relay front there shall be a must control authority in terms of LOCAL and REMOTE either by lock and key or by any fascia button (which can also be initiated by Binary or digital input) so that on choosing LOCAL it does not accept any remote command.

4.3 Protection and Control Philosophy: Major Components as Follows:

4.3.1 Feeder Protection Relay (Dir O/C & E/F Relay)

Protection Functionalities shall be as follows:

- Non Directional (50/51 & 50N/51N) & Directional O/C and E/F (each element shall have one IDMTL and three high set definite time relay) (67 R, Y, B and 67N)
- Negative sequence current (unbalance current) (46)
- Overload relay (49)
- VT supervision relay and Trip circuit supervision relay.
- Integrated CB failure protection.
- Configurable LEDs shall be provided to indicate the IED operation and the alarm /status change of a bay equipment e.g. Phase Fault operated / Earth Fault operated / CB Open / CB Close / Spring charged etc.
- Auto Reclose (79) Protection element feature to be incorporated.
- The LED should have Circuit Breaker monitoring >1 KA square for online monitoring Breaker
- Synch-check functionality.
- The IED should have Graphical Display Unit to display bay level information
- Electrically reset type high speed, heavy duty relay (master trip 86) shall be used for tripping on operation of main and BCPU IEDs. The two trip coils where ever provided shall be provided with independent potential free contacts from different fused DC supplies. The trip relay shall be supervised. Master trip relay should be such that on resetting its flag should be automatically reset.
- Breaker counter logic shall be there on fault opening
- The lED must have broken conductor and fault locator facility
- IED of Bus Coupler/Bus Section Bay should have minimum of 15 Digital Inputs and Digital Output Channels for Substation and other Aux. Signals
- Reverse blocking and CB FP shall be implemented for all I/C & O/G Breakers.
- Auto reclosing (79) Protection element feature to be incorporated in the IED.
- The IED shall provide all necessary interlocking for Grid station within the bay.
- The IED should have Circuit Breaker Health Monitoring (Cumulative I2t)
    - No of DI :24
    - No of DO:14

4.3.2 Transformer Protection Relay

The lED shall have biased current Differential protection with REF, SEF and Directional O/C & E/F protection. It should include the following features:

- Vector group compensation.
- CT ratio correction.
- Biased differential protection.
- High-set. Element of suitable setting range
- 2nd and 5th Harmonic restrains

Transformer trouble alarm/ Trip e.g. Buchholz Relay PRO / Winding Temp / Oil Temp etc. shall be taken as binary inputs through aux relays to the differential lED as a common input indicating "Transformer trouble" . However, auxiliary Flag relays / TMU (Transformer monitoring unit) shall be provided independently for Transformer trouble and trip along with the panel.

- No of DI :16
- No of DO:10

4.3.3 Capacitor Protection Relay

A dedicated high speed Numerical Current operated Neutral Unbalance / Displacement lED with Provision of two stages of definite time elements shall be provided as Main Protection.
IED shall be able to display all the Alarms and field status change on the LCD panel of the IED at the time of occurrence and it should be possible to accept the alarms locally from the IED and through the station controller PC.

- No of DI :16
- No of DO:10

In addition to protective relays, there are other components comprising of but not limited to:

4.3.4 Master Trip Relay (86)

Electrically reset type high speed, heavy duty relay (master trip relay 86)) shall be used for tripping on operation of protection IEDs. Trip relay along with tripping circuit shall be supervised. Master trip relay should be such that on resetting its flag should be automatically reset.

Number of potential free contacts: 6NO +2NC Preferred Make & Model: ABB/GE (Ring type interface / Combiflex shall be decided during detailed engineering)

4.3.5 DC Supervision Relay

DC operated Auxiliary Relay for DC Supply Supervision. Aux Voltage: 24/48 VDC based on system Control voltage. Number of potential free contacts: 1NO + 2NC

Preferred Make & Model: ABB/GE (Ring type interface / Combiflex shall be decided during detailed engineering)

4.3.6 Trip Circuit Supervision Relay

For Pre & Post Close Supervision (2 Trip Circuits)

Number of potential free contacts: 1NO + 2NC

Aux voltage: 24/48 V DC Based on System Control voltage. Preferred Make & Model: ABB/GE (Ring type interface / Combiflex shall be decided during detailed engineering)

4.3.7 Aux Relay for transformer Protection (Applicable for Transformer CRP Only)

Two Element Aux relay for Transformer Protection

- OTI Trip & Alarm
- WTI Trip & Alarm
- Buchholz Trip & Alarm
- PRV Trip
- MOG Alarm
- OLTC PRV Trip
- OSR Trip

Number of potential free contacts: 4 NO
Aux voltage: 24/48 VDC Based on System Control voltage. Preferred Make & Model: ABB/GE (Ring type interface / Combiflex shall be decided during detailed engineering)

4.3.8 Multi-Function Meter

For measurement and display of Voltage, Current, Power and Power Factor.

4.3.9 Selection of IED for Control & Relay Panel

a) 33kV/11kV Power Transformer CRP
b) CRP for Transformer shall be provided with two Protective Relays:
   i. Main Protection: As per clause 4.3.2
   ii. Back-up Protection: As per clause 4.3.1

1. 11 KV Feeder, Incomer, BC CRP
   i. CRP for Feeder shall be provided with one Protective Relays.
   ii. It shall be as per clause 4.3.1
   iii. 33 KV Line CRP
   iv. CRP for Feeder shall be provided with one Protective Relays.
   v. It shall be as per clause 4.3.1
2. 11KV Capacitor CRP
   i. CRP for Feeder shall be provided with Two Protective Relays.
      - Main Relay : It shall be as per clause 4.3.3
      - Backup Relay : It shall be as per clause 4.3.1

a) Automatic power factor controller module embedded in the IED for auto switching of breaker shall take into consideration the bus voltage & pf. 11KV I/C current Input to the Neutral current unbalance IED shall be from CT installed on the connection between two star points of the capacitor bank.

b) Electrically reset type high speed relay shall be used for tripping & the trip relay shall be supervised.

4.4 Detailed Requirement of Hardware & Software of the Numerical Protection IEDs:

i. All numerical IEDs, auxiliary IEDs and devices comprising the Bay Protection Units shall be of types, proven for the application, satisfying the requirements specified in technical specifications and shall be subject to the Owner's approval. Numerical IEDs shall have appropriate setting ranges, accuracy, resetting ratio, transient overreach and other characteristics to provide the required sensitivity to the satisfaction of the Owner.

ii. All IEDs must have conformal coating for protection against harsh environments.

iii. Bidder shall provide necessary certificates to ascertain the communication capability (Interoperability) with other make LED in 61850 standard for interlocks/logic through GOOSE messaging. The relays provided for any project must have self-diagnostic feature to enable us to know about component failure. if not possible then necessary software to detect the same must be provided.

iv. Equipment shall be designed for a working life of at least fifteen years in the specified environment and application. Components, component ratings and all other factors determining equipment life shall take this into account. Normal routine and breakdown maintenance shall be assumed and it is accepted that certain consumable components and modules may need periodic replacement or adjustment. However, the Bidder shall state in his bid, the expected frequency of such replacement or adjustment and life expectancy.

v. Numerical IEDs shall be suitable for efficient and reliable operation of the protection scheme. The necessary auxiliary relays, trip relays, etc. required for complete scheme, interlocking, alarm, logging, etc. shall be provided. No control IED, which shall trip the circuit breaker when the lED is de-energized, shall be employed in the circuits. Any connectors, terminals, switches required to extend or isolate the wiring to IEDs to be provided by bidder.

vi. IEDs shall be provided with self-reset contacts except for the trip lockout, which shall have

vii. Contacts with an electrical reset feature.

viii. Suitable measures shall be provided to ensure that transients present in CT & VT connections due to extraneous sources in the HV system do not cause damage to the numerical and other IEDs. CT saturation shall not cause mal-operation of numerical IEDs.

ix. Hardware selection should be done in such a manner that all power supply requirements could be met with the available grid voltages (24VDC/48V DC for grid station).

x. DC batteries in protective IEDs necessary for IED operation shall not be acceptable.

Equipment shall be protected against voltage spikes in the auxiliary DC supply. Auxiliary supply supervision and necessary alarm generation to SCADA be possible.

xi. The numerical IEDs shall have continuous self-monitoring & cyclical test facilities. The internal clock of the system shall be synchronized through the GPS Time Synchronizing System to be provided by Owner at later date.

xii. Each numerical IED shall have a serial interface on the front for local communication to Personal Computer and Printer. Facilities shall be provided to access each discrete protection function including modification in IED settings and monitoring of. the IED from a HMI. A print out of all settings, scheme logic, event records etc. shall be accessible through the HMI. The display of various measured parameters during normal as well as fault conditions on a segregated phase basis shall be provided. LEDs and a backlit LCD screen shall be provided for visual indication and display of messages related to major trips / alarms. Necessary multilevel password protection shall be provided.

xiii. The sampling rate of analog inputs, the processing speed and processing cycle of digital values shall be selected so as to achieve the operating times of various protection functions specified. In case the Bidder does not have all the protection functions specified as a part of the standard numerical IED, separate discrete numerical IEDs can be provided for such protection. The reasons for providing such discrete IEDs shall be clearly outlined in the bid.

xiv. The numerical IEDs shall be provided with built-in disturbance recording functionality. The data from DR function shall be available in IEEE/COMTRADE format and shall be compatible with the dynamic IED test system being supplied under this Contract.

xv. The manufacturer of the numerical protection system offered shall carry out the complete engineering, testing and commissioning on site of the offered protection equipment including the associated IEDs and protection panels. The testing and commissioning protocols for the numerical protection systems offered shall be approved by the owner before commissioning on site.

xvi. The numerical IEDs offered shall have self-diagnostic features to reduce the down time of the IED and to provide useful diagnostic information upon detection of an internal fault so as to speed up the maintenance. The necessary support documentation explaining in detail the self-diagnostic features of the numerical IEDs shall be furnished for the Owner's use, Self-diagnostic feature to meet clause 7.1.2.4 of IEC 61850-4.

xvii. There should also be separate logic in IED to cater breaker operation counter on faults only

xviii. PRP/RSTP to be made available by default in relay with dual RJ45 or dual FO Port.

xix. Fault currents sensed by relay to be mapped to SCADA. Proper programming to be done for the same.

xx. All the protection signals along with corresponding LEDs to be latched at SCADA, so suitable logic to be built in the relay.

xxi. On resetting the BCPU/PU from SCADA or Locally from relay all the protection signals must

be get reset both at SCADA and at relay with relay outputs in one go. if separate logics required to meet the same, then same can be formulized.

xxii. Device order code of 11kV IEDs (BCPUs & PUs) must have same order codes irrespective of panel types for better IEC61850 project management and one to one replacement. For 111(V panels both BCPU and PU order code will be the same. Device order code of 33kV & 11kV BCPUs must have same order code for better IEC 61850 project management and one to one replacement.

xxiii. The bidder shall provide all software licenses for all the software being used in Protection IED offered for engineering, IED setting uploading and FDR downloading etc. The license shall be provided on a site license basis and shall be valid for the plant / Equipment life cycle. In the case of anti-virus software, the license shall include regular updates. The Bidder Shall guarantee that all software are defect free and meet the System specifications, and undertake to fix any defects Which may arise during the life of the system at no cost to the Owner.

xxiv. In case offered IEDs require any additional software for its integration to RTU then the bidder shall provide the same.

xxv. All software versions in components shall be the latest official releases as on the date of shipment from works and shall include all software updates etc. released till that date. A certificate to this effect shall be furnished by the bidder at the time of pre-dispatch inspection for each software package. All new software revisions and/or

xxvi. patch updates that are released before the end of the warranty period which addresses system defects shall be implemented on site and the system re-tested to validate system integrity by the bidder at no cost to the owner (This excludes new revisions which provides additional functionality). The bidder shall periodically inform the designated officer of the Owner about software updates / new releases that would be taking place after the system is commissioned.

xxvii. Bidder shall train our engineers to guide the upgrading procedures of project files with respect to latest releases.

xxviii. Two nos. of communication cords for each type of relay uploading and clown loading data from front and rear port of Protection IED shall be supplied by the bidder. One no. of Serial to USE Converter to be supplied by bidder.

xxix. Station Project Files shall be ready before raising inspection call & submission of the internal test report by the vendor

xxx. Vendor shall submit 2 copies of as built drawings & station project files in soft format.

4.3 GPS Clock

The offered GPS Clock should meet the following requirements:

- Redundant GPS based Time Synchronization Server with Antenna
- Tracking: 12 Satellites in parallel

- LCD Display with Status LED's
- Redundant Ethernet Port
- NTP v2/v3/v4
- IPv4, lPv6, UDR, TCP, SNMP, SSH, SCP, HTTP, HTTPS, SYSLOG, Telnet, FTP Networking protocols
- Remote Alarm notifications via SNMP, SYSLOG
- Remote configuration using SSH, Web, SNMP, Telnet
- USB Port
- Supports synchronization of IFC61850 compliant devices via NTP/SNTP/PTP protocol
- Mounting Type: 19" Rack Mountable
- NTP Client Synchronization software
- Diagnostic Relay outputs
- Supporting Timing Protocols:
  a) NTP/SNTP
  b) PTP v2
  c) IRIG-B Modulated
  d) IRIG-E3T11
- Power Supply: Redundant, 48VDC ± 15% or 220VDC ± 15%
- Operating Temperature: 0° C to +55° C
- Alarms:
  a) GPS Lost
  b) Watchdog
  c) Power Fail
- Antenna: Coaxial Cable with 360 Degree Coverage

4.17 Fibre Optic Cable (Optional)

Between Control Room and Switchyard/Switchgear Room: 4 Core, 62.5/125 micro metre Multi-mode, Loose tube, Jelly filled, Armoured Fibre optic cable within Control Room: 2 Core, 623/1251.tm Multi-mode Fiber Optic Patch Chord.

4.18 CAT-VI

4 Pairs, 23 AWG Solid Bare Copper Conductor, PE Insulation, Unshielded Twisted Pair (UTP) with separator and PVC Outer Jacket

It should be designed to the ANSI/TIA-568-C.2 ISO IEC 11801 Category 6 requirements and transmit data at 1000 M bps (-1 Gigabit per second} with a frequency of 250 MHz and suitable for 1OBASE-T, 100BASE-TX Fast Ethernet and 1000BASE-T 100013ASE-TX (Gigabit Ethernet).

4.19 Energy meter

Provision for installation of Revenue type Smart Energy meter to be provided C&R Panel including the TTB & other related items.

5 GENERAL CONSTRUCTIONS

General Construction of CRP

Panel Fabrication wise CRPs are classified into 2 Types :

A) Indoor Type CRP

B) Outdoor Type CRP

BA to supply Indoor type CRP only, unless Outdoor CRP is specifically mentioned in Tender.

A) Outdoor Type CRP:

It shall comply to all technical requirement of indoor CRP .Additionally it shall also comply to following requirements:

- Outdoor type panel shall be designed for IP65 rating.
- It shall be suitable for Outdoor application having Canopy with Primary Door with Glass for Visual Inspection and Secondary Door having all necessary mountings
- It shall be supplied with suitable Channel Mounting Arrangement so as to ensure CRP base remains at a height of 500mm from FGL.
- It shall have an Outer Primary Door with Glass Sheet for clear line of sight for Indications and Readings without opening the Door.
- Relays, LEDs, Meters etc shall be mounted on Inner Secondary Door .
- Panels to be provided with suitable canopy
- CRP shall be Front access Only.

B) Indoor Type CRP:

Indoor type panel shall be designed for IP55 rating.

11KV/ 33KV control and relay panel. Following features to be ensured.

5.1 Simplex Panel

Simplex panel with Water and Dust proof design shall consist of a vertical front panel with Relays,Meters, mounted on Inner Door thereon and having wiring access from Front for control panels. In case of panel having width equal to or more than 800mm, double leaf-doors shall be provided. Doors shall have handles with either built-in locking facility or will be provided with pad-lock.

5.2 Constructional features

Design must be Type Tested for Ingress Protection.

It is the responsibility of the BA to ensure that the equipment specified and such unspecified complementary equipment required for completeness of the protective/control schemes is properly accommodated in the panels without congestion and if necessary, provide panels with larger dimensions. No price increase at a later date on this account shall be allowed. However, the width of panels that are being offered to be placed in existing switchyard control rooms, should be in conformity with the space availability in the control room.

Panels shall be completely metal enclosed and shall he dust, moisture and vermin proof. The enclosure shall provide a degree of protection not less than IP-55 in accordance with IS: 2147. Panels shall be free standing, floor mounting type and shall comprise structural frames completely enclosed with specially selected smooth finished, cold rolled sheet steel of thickness not less than 3 mm for weight bearing members of the panels such as base frame, front sheet and door frames, and 2.0mm for sides, door, top and bottom portions. There shall be sufficient reinforcement to provide level

Transportation and installation. All doors, removable covers and panels shall be gasketed all around with synthetic rubber gaskets Neoprene/EPDIV1 generally conforming to provision of IS 11149. However, XLPE gaskets can also be used for fixing protective glass doors. Ventilating louvers, if provided shall have screens and filters, The screens shall be made of either brass or GI wire mesh. Design, materials selection and workmanship shall be such as to result in neat appearance, inside and outside with no welds, rivets or bolt head apparent from outside, with all exterior surfaces tune and smooth. Panels shall have dual exhaust fan for dissipation of heat.

Panels shall have base frame with smooth bearing surface, which shall he fixed on the embedded foundation channels/insert plates. Anti-vibration strips made of shock absorbing materials that shall be supplied by the contractor, shall be placed between panel of base frame, Cable entries to the panels shall be from the bottom. Cable gland plate fitted on the bottom of the panel shall he connected to earthing of the panel/station through a flexible braided copper conductor rigidly. Relay panels of modern modular construction would also be acceptable.

5.3 Mounting

All equipment on and in panels shall be mounted and completely wired to the terminal blocks ready for- external connections. The equipment on front of Inside Secondary Door shall he mounted flush. Equipment .shall be mounted such that removal and replacement can be accomplished individually without interruption of service to adjacent devices and are readily accessible without use of special tools. Terminal marking-on the equipment shall be clearly visible.

The BA shall carry out cut out, mounting and wiring of the free issue items supplied by others which are to be mounted in his panel in accordance with the corresponding equipment manufacturer drawings. Cut outs if any, provided for future mounting of equipment shall be properly blanked off with blanking plate.

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

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

matched.

No equipment shall be mounted on the doors. At existing stations panels shall be matched with other panels in the control room in respect of dimensions, colour, appearance and arrangement of equipment (center lines of switches, push buttons and other equipment) on the front of the panel.

5.4 Panel internal Wiring

Panels shall be supplied complete with interconnecting wiring provided between all electrical devices mounted and wired in the panels and between the devices and terminal blocks for the devices to be connected to equipment outside the panels. When panels are arranged to be located adjacent to each other all inter panel wiring and connections between the panels shall be furnished and the wiring shall be carried out internally, this is in the BA's scope.

All wiring shall be carried out with 1100V grade, single core, stranded copper conductor wires with PVC insulation with FRLS type. The minimum size of the multi-stranded copper conductor used for internal wiring shall be as follows:

Internal wiring to be connected to external equipment shall terminate on terminal blocks.

The terminal blocks for CTs VT's shall be provided with test links and isolating facilities, The CT terminal blocks shall be provided with short circuiting and earthing facilities.

Shall have 20% terminals as spare terminals in each panel. All equipment mounted on front of the panels shall have individual name-plates with equipment designation engraved. Each panel shall also have circuit/feeder designation name plate.

All wiring shall be with 1100 V grade, single core, PVC insulated stranded copper conductor, FRLS type Wires shall be vermin proof. Minimum size of conductor shall be 2.5 sq. mm in general, but for CT & VT.

Contractor shall be solely responsible for completeness and correctness of all the wiring, and for proper functioning of the connected equipment.

Specification for Auxiliary relays /MCB's

- Fuse Failure relay and trip Circuit Supervision relay shall be suitably selected, considering burden and auxiliary voltage. External circuitry like compensating resistances will not be accepted.
- Auxiliary contact multiplier relays should be of reputed make and selected on the basis of continuous current carrying capacity and rated voltage. The fluctuation in voltage level must be accounted for (+/-) 10% continuously.
- DC MCB's should not be substituted by AC MCB's for DC-Distribution, irrespective of manufacturer's individual multi usage Recommendations.

- DC Fail Supervision relay (80) shall be provided on all control and IED panels.

Spare I/Os wiring shall be brought upto terminal block for future use.

All internal wiring shall be securely supported, neatly arranged, readily accessible and connected to equipment terminals and terminal blocks. Wiring gutters & troughs shall be used for this purpose. Auxiliary bus wiring for AC and DC supplies, voltage transformer circuits, annunciation circuits and other common services shall be provided near the top of the panels running throughout the entire length of the panels.

Wire termination shall be made with solder less crimping type and tinned copper lugs, which firmly grip the conductor. Insulated sleeves shall be provided at all the wire terminations.

Engraved core identification plastic ferrules marked to correspond with panel wiring diagram shall be fitted at both ends of each wire. Ferrules shall fit tightly on the wire and shall not fall off when the wire is disconnected from terminal blocks. All wires directly connected to trip circuit breaker or device shall be distinguished by the addition of red coloured un lettered ferrule.

Longitudinal troughs extending throughout the run length of the panel shall he preferred for inter panel wiring. Inter-connections to adjacent panel shall be brought out to a separate set of terminal blocks located near the slots of holes meant for taking the inter-connecting wires

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

5.5 Terminal Blocks

All internal wiring to be connected to external equipment shall terminate on terminal blocks.

Terminal blocks shall be 1100 V grade and have 10 Amps. Continuous rating, moulded piece, complete with insulated barriers, stud type terminals, washers, nuts and lock nuts. Markings on the terminal blocks shall correspond to wire number and terminal numbers on the wiring diagrams. All terminal blocks shall have shrouding with transparent unbreakable material.

Disconnecting type terminal blocks for AC/DC, current transformer and voltage transformer secondary leads shall be provided. Also current transformer secondary leads shall be provided with short circuiting and earthing facilities.

At least 20% spare terminals shall be provided on each panel and these spare terminals shall be uniformly distributed on all terminal blocks.

Unless otherwise specified, terminal blocks shall be suitable for connecting the following conductors of external cable on each side

- All CT & PT circuits: minimum of 2.5 sq. mm copper. (FRLS)
- AC/DC Power Supply Circuits: 2.5 sq. mm Copper. (FRLS)
- All other circuits: 2.5 sq. mm Copper. (FRLS)
- Control Circuit: 2.5 sq. mm Copper. (FRLS)

There shall be a minimum clearance of 250 mm between the first row of terminal blocks and the associated cable gland plate or panel side wall. Also the clearance between two rows of

terminal blacks edges shall be minimum of 150mm.

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

The number and sizes of the TPCODL/TPNODL/TPSODL/TPWODL s multi core incoming external cables will be furnished to the BA after placement of the order. All necessary cable terminating accessories such as gland plates, supporting clamps & brackets, wiring troughs and gutters etc. (except glands & lugs) for external cables shall be included the scope of supply.

5.6 Painting

All sheet steel work shall be phosphate in accordance with the IS: 6005 "Code of practice for phosphate iron and steel". It should follow the seven tank process. Oil, grease, dirt shall be thoroughly removed by emulsion cleaning. Rust and scale shall he removed by pickling with. Dilute acid followed by washing with running water rinsing with a slightly alkaline hot water and drying. After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and oven drying. The phosphate coating shall be sealed with application of two coats of ready mixed, staved type zinc chromate primer. The first coat may be "flash dried" while the second coat shall be staved. Thereafter an established painting procedure like electrostatic painting followed for powder coating the panel. The colour shade shall be Siemens grey RAL 7032.

5.7 Miscellaneous Accessories

Plug Point: 24011, Single phase 50Hz, AC socket with switch suitable to accept 5 Amps and 15Amps pinround standard Iridian plug, shall be provided in the interior of each cubicle with ON-OFF switch.

Interior Lighting: Each panel shall be provided with an LED: lighting fixture rated for 240 Volts, single phase, 50 Hz supply for the interior illumination of the panel controlled by the respective panel door switch.

Switches and Fuses: Each panel shall be provided with necessary arrangements for receiving, distributing and isolating of DC and AC supplies for various control, signaling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with miniature circuit breakers (MCB). Selection of the main and sub-circuit MCB rating shall be such as to ensure selective clearance of sub-circuit faults. MCBs shall confirm to IS: 13947. Each IVICB shall be

provided with one potential free contact and the same shall be wired for annunciation purpose. However voltage transformer circuits for relaying and metering shall be protected by fuses. All fuses shall he HRC cartridge type conforming to IS: 13703 mounted on plug-in type fuse bases. Fuse carrier base as well as MCBs shall have imprints of the fuse `rating' and 'voltage'.

Space Heater: Each panel shall be provided with a space heater rated for 240V, single phase, 50 Hz Ac supply for the internal heating of the panel to prevent condensation of moisture. The fittings shall be complete with switch unit.

5.8 Earthing: All panels shall be equipped with an earth bus securely fixed. Location of earth bus shall ensure no radiation interference for earth systems under various switching conditions of isolators and breakers. The material and the sizes of the bus bar shall be at least 25 X 6 sq.mm perforated copper with threaded holes at a gap of 50mm with a provision of bolts and nuts for connection with cable armors and mounted equipment etc for effective earthing, When several panels are Mounted adjoining each other, the earth bus shall be made continuous and necessary connectors and clamps for this purpose shall be included in the scope of supply of the Contractor. Provision shall he made for extending the earth bus bars to future adjoining panels on either side.

Provision shall be made on each bus bar of the end panels for connecting Substation earthing grid. Necessary terminal clamps and connectors for this purpose shall be included in the scope of supply of BA.

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

Looping of earth connections, which would result in loss of earth connection to other devices when the loop is broker, shall not be permitted. However, looping of earth connections between equipment to provide alternative paths to earth bus shall he provided.

VT and CT secondary neutral or common lead shall be earthed at one place only at the terminal blocks where they enter the panel. Such earthing shall be made through l inks so that earthing may be removed from one group without disturbing continuity of earthing system for other groups.

5.9 Switches

Control and instrument switches shall be rotary operated type with escutcheon plates clearly marked to show operating position and circuit designation plates and suitable for f lush mounting with only switch front plate and operating handle projecting out.

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

- Breaker, Isolator: Pistol grip, black control switches

- Selector switches: Oval or knob, black
- Instrument switches: Round, knurled, black

The control switch of breaker and isolator shall be of spring return to neutral type. The switch shall have spring return from close and trip positions to "after close" and "after trip" positions respectively. Instrument selection switches shall be of maintained contact (stay put) type. Ammeter selection switches shall have make-before-break type contacts so as to prevent open circuiting of CT secondary when changing the position of the switch. Voltmeter transfer switches for AC shall be suitable for reading all line- to-line and line-to-neutral voltages for non-effectively earthed systems and for reading all line to line voltages for effectively earthed systems.
Lockable type of switches which can be locked In particular positions shall be provided when specified. The key locks shall be fitted on the operating handles.
The contacts of all switches shall preferably open and close with snap action to minimize arcing. Contacts of switches shall he spring assisted and contact faces shall be with rivets of pure silver or silver alloy. Springs shall not be used as current carrying parts
The contact combination and their operation shall be such as to give completeness to the interlock and function of the scheme.

The contact rating of the switches shall be as follows:

Description	24 VDC	48 VDC
Make and Carry	10	10
Continuously Make and Carry for 0/5 Sec	30	30
Break for resistive Load	3	20
Inductive Load for L/R=40ms	0.2	

5.10 Indicating Lamps

Indicating lamps shall he of cluster LED type suitable for panel mounting with rear terminal Connections. Lamps shall be provided with series connected resistors preferably built in the lamp assembly. Lamps shall have translucent lamp covers to diffuse lights colored red, green, amber, dear white or blue as specified the lamp cover shall be preferably of screwed type, unbreakable and moulded from heat resisting material.
The lamps shall be provided with suitable resistors. Lamps and lenses shall be interchangeable and easily replaceable from the front of the panel. Tools, if required for replacing the bulbs and lenses shall also be included in the scope of the supply.
The indicating lamps with resistors shall withstand 120% of rated voltage on a continuous basis.

LED Colour shall be as follows:
CB Open: Green
CB Closed: Red
CB Spring Charged: Blue

Auto Trip: Amber
TCS: White
R, Y, B Phase Healthy: Red/Yellow/Blue

6. MARKING

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

All front mounted equipment shall also be provided at the rear with individual name plates engraved with tag numbers corresponding to the one shown in the panel internal wiring to facilitate easy tracing of the wiring.

Each IED and meter shall be prominently marked. All relays- and other devices shall be clearly marked with manufacturer's name, manufacturer's type, serial number and electrical rating data. Name Plates shall be made of anodized aluminium. Name plates shall be black with white engraving lettering. Each switch shall bear clear inscription identifying its function e.g. 'BREAKER"52A', "SYNCHRONISING" etc. Similar inscription shall also be provided on each device whose function is not other-wise identified. If any switch device does not bear this inscription separate name plate giving its function shall be provided for it. Switch shall also have clear inscription for each position indication e.g. "Trip- Neutral-Close", "ON-OFF% "R-Y-B-OFF" etc.

All the panels shall be provided with name plate mounted inside the panel bearing PO No & Date, Name of the Substation & feeder and reference drawing number.

7. TESTS

Factory Acceptance Test:

The manufacturing phase of the C&R Panel shall be concluded by the factory acceptance test (FAT). The purpose is to ensure that the Contractor has interpreted the specified requirements correctly and that the FAT includes checking to the degree required by the user. The general philosophy shall be to deliver a system to site only after it has been thoroughly tested and its specified performance has been verified, as far as site conditions can be simulated in a test lab. If the FAT comprises only a certain portion of the system for practical reason, IED Configuration and Database shall be prepared completely as per actual site requirement and it will submit to TPCODL/TPNODL/TPSODL/TPWODL for validation. An integrated-FAT shall be conducted as per the TPCODL/TPNODL/TPSODL/TPWODL Guidelines. If the complete system consists of parts from various suppliers or some parts are already installed on site, in such case supplier will arrange the intra-communication between RTLVDC and such IEDs to meet the requirement.

Hardware Integration Tests shall be performed on the specified systems to be used for Factory

tests when the hardware has been installed in the factory. The operation of each item shall be verified as an integral part of system. Applicable hardware diagnostics shall be used to verify that each hardware component is completely operational and assembled into a configuration capable of supporting software integration and factory testing of the system. The equipment expansion capability shall also be verified during the hardware integration tests.

Integrated System Tests shall verify the stability of the hardware and the software. During the tests all functions shall run concurrently and all equipment shall operate a continuous 100 Hours period. The integrated system test shall ensure the IEDs is free of improper interactions between software and hardware while the system is operating as a whole.

8.0 Type test Certificate

Test reports for following type tests shall be submitted for the Protection IED along with the Bid

		S. No.	Description	Standard
8.1	Insulation test	1	Dielectric Withstand Test	IEC 60255-5
				ANSI/IEEE C37.90-1989
				2kV rms for 1 minute between all case terminals connected together and the case earth
				2kV rms for 1 minute between all terminals of independent circuits with terminals on each independent circuit connected together.
				1KV rms for 1 min across the open contacts of the witchdog IED
				1KV rms for Minute across open contacts of the changeover output IEDs
				1.5KV rms for 1 minute across open contacts of normally open output IEDs
		2	High Voltage Impulse Test, class III	IEC 60255-5
				5kV peak; 1.2/50 sec; 0.5J; 3 positive and 3 negative shots at intervals of 5s
8.2	Electrical Environment Tests	1	DC Supply Interruption	IEC 60255-11
				The unit will withstand a 20ms interruption in the auxiliary supply, in its quiescent state, Without de-energizing.
		2	AC Ripple on DC supply	IEC 60255-11The unit will withstand a 12% ac ripple on the dc supply.
		3	AC voltage dips and short Interruptions	IEC 61000-4-11 20ms
				interruptions/ dips.
		4	High Frequency Disturbance	IEC 60255 22 1, class III
				At 1MHz, for 2s with 200 ohms source impedance:2.5kV peak; 1 MHz; T = 15 sec; 400
				shots/ sec; duration 2 sec between independent circuits and independent circuits and case earth. 1.0kV peak across terminals of

				the same circuit.
		5	Fast Transient Disturbance	IEC 60255-22-4, class IV
				4kV, 2.5kHz applied directly to auxiliary supply 4kV, 2.5kHz applied to all inputs.
		6	Surge Withstand Capability	IEEE/ANSI C37.90.1 (1989)
				4kV fast transient and 2.5kV oscillatory applied directly across each output contact, optically isolated input and power supply circuit.
		7	Radiated Immunity	C37.90.2: 1995
				25MHz to 1000MHz, zero and 100% square wave modulated. Field strength of 35V/m.
		8	Electrostatic Discharge	IEC 60255-22-2 Class 4
				15kV discharge in air to user interface, display and exposed metal work.
				IEC 60255-22-2 Class 3
				8kV discharge in air to all communication ports. 6kV point contact discharge to any part of the front of the product.
		9	Surge Immunity	IEC 61000-4-5: 1995 Level 4
				4kV peak, 1.2/50ms between all groups and case earth.
				2kV peak, 1.2/50ms between terminals of each group.
		10	Capacitor Discharge	No change of state or any operation shall occur when a capacitor of capacitance shown below, charged to 1.5 Vn volts, is connected between any combination of terminals and any combination of terminals and ground.
				Master trip circuits - 10 F Other protection & control circuits - 2 F
				Carrier/channel interface - 0,2 F
8.3	EMC Test	1	Radio- Frequency Electromagneti c Field, Non-Modulated	IEC 60255 22 2, class III
				10 V/m; 27 MHz to 500 MHz
		2	Radio- Frequency Electromagnetic Field, Amplitude Modulated	ENV 50140, class III
				10 V/m; 80 MHz to 1000 MHz;
				80% AM; 1 kHz
		3	Radio- Frequency Electromagneti c Field, Pulse Modulated	ENV 50140/ENV 50204
				10 V/m; 900 MHz; repetition frequency 200 Hz; duty cycle 50 %
		4	Disturbances Induced by Radio	ENV 50141, class III
				30 A/m continuous; 300 A/m

			Frequency fields,Amplitude Modulated	for 3 sec; 50 Hz
		5	Power Frequency Magnetic Field	EN 61000-4-8, class IV
				30 A/m continuous; 300 A/m
				for 3 sec; 50 Hz
		6	Interference Voltage, Aux.Voltage	EN 50081-*
				150 kHz to 30 MHz
		7	Interference Field Strength	EN 50081-*
				30 MHz to 1000 MHz
8.4	Atmospheric Environment Test	1	Temperature	IEC 60255-6
				Operating 25 o C to +55 C
				Storage and transit 25 o C to +70C
				IEC 60068-2-1 for Cold
				IEC 60068-2-2 for Dry heat
		2	Humidity	IEC 60068-2-3
				56 days at 93% RH and +40oC
8.5	Mechanical Stress Test	1	Vibration (during Operation & Transportation)	IEC 255-21-1; IEC 68-2-6
				Response Class 2
				Endurance Class 2
		2	Shock (during Operation and Transportation)	IEC 255-21-2, class 1, IEC 68-
				2-27 Shock response Class 2 Shock withstand Class 1 Bump Class 1
		3	Seismic Vibration (during Operation)	IEC 60255-21-3 Class 2
		4	Continuous Shock (during Transportation)	IEC 255-21-2, class 1, IEC 68-2-27
8.6	Ingress Protection	1	Type Test for IP66	

9. PRE DISPATCH INSPECTION

Equipment shall be subject to inspection by a duly authorized representative of the Purchaser as detailed at Clause No.6.0. Inspection may be made at any stage of manufacture at the option of the purchaser and the equipment if found unsatisfactory as to workmanship or material, the same is liable to rejection.

Bidder shall grant free access to the places of manufacture to Purchaser's representatives at all times when the work is in progress. Inspection by the Purchaser or its authorized representatives shall not relieve the supplier of his obligation of furnishing equipment in accordance with the specifications Material shall be dispatched after specific MDCC (Material Dispatch Clearance Certificate) is issued by the Purchaser.

Following documents shall be sent along with material

a) Test reports
b) MDCC issued by TPCODL/TPNODL/TPSODL/TPWODL
c) Invoice in duplicate
d) Packing list
e) Drawings & catalogue
f) Guarantee / Warranty card
g) Delivery Challan
h) Other Documents (as applicable)

10. INSPECTION AFTER RECEIPT AT STORES

Equipment/material received at shall be inspected by Stores liable for rejection, if found different from pre dispatch inspection report

One copy of the Inspection Report shall be sent to the Plant Engineering and Protection & Testing Departments.

11. GUARANTEE

Bidder shall stand guarantee towards design, materials, workmanship & quality of process/manufacturing of items under the contract for due and intended performance of the same, as an integrated product delivered under this contract. In the event any defect is found by the Company up to a period of 60 months from the date of commissioning supplier shall be liable to undertake to replace/rectify such defects at his own costs within the mutually agreed timeframe, and to the entire satisfaction of the Company, failing which the Company will be at liberty to get it replaced/rectified at supplier's risks and costs and recover all such expenses plus the Company's own charges (@ 20% of expenses incurred), from the supplier or from the "Security cum Performance Deposit" as the case may be.

Bidder shall further be responsible for 'free replacement' for another period of three years from the end of the guarantee period for any 'Latent Defects' if noticed and reported by the Company

12. PACKING

Bidder shall ensure that all equipment covered by this specification shall be prepared for rail/road transport (local equipment) and be packed in such a manner as to protect it from damage in transit.

13. TENDER SAMPLE : NA

14. TRAINING :

The successful Bidder shall provide training for relay configuration with goose messaging, data concentrator at supplier's works - 4 persons 3 days minimum to Owners Engineers before dispatch. Venue of the training shall be Bidders works or TPCODL/TPNODL/TPSODL/TPWODL Office and same shall be finalized by TPCODL/TPNODL/TPSODL/TPWODL at the time of project closure/completion of SAT. The training shall cover Engineering configuration of the IED. IED setting calculations, training

However, lodging/boarding/transportation of trainees shall be borne by TPCODL/TPNODL/TPSODL/TPWODL.

Supplier personnel who are experienced instructor s and who speak understandable English shall conduct training. The Supplier shall arrange on its own cost all hardware training platform required for successful training and understanding in India at manufacturer's work. The Supplier shall provide all necessary training material including configuration document in advance. Each trainee shall receive individual copies of all technical manuals and all other documents used for training. Class materials, including the documents sent before the training courses as well as class handouts, shall become the property of Employer. Employer reserves the right to copy such materials, but for in- house training and use only. Hands-on training shall utilize equipment identical to that being supplied to Employer. For all training courses, the travel (e.g., airfare) and per-diem expenses will borne by the participants. The schedule, location, and detailed contents of each course will be finalized during Employer and Supplier discussions. uploading/ downloading, secondary injection testing on computerized IED testing kit, checking of DC logic etc. No extra charges shall be payable for

15. QUALITY CONTROL

The bidder shall submit with the offer, quality assurance plan indicating the various stages of inspection, the tests and checks which will be carried out on the material of construction, components during manufacture and after finishing, bought out items and fully assembled component and equipment including drives. As part of the plan, a schedule for stage and final inspection within the parameters of the delivery schedule shall be furnished. The purchaser's engineer or its nominated representative shall have free access to the manufacturer/sub-supplier's works to carry out inspections.

16. MINIMUM TESTING FACILITIES

The Bidder shall have in house testing facilities for carrying out all routine tests and acceptance tests as per relevant international/Indian standards.

17. MANUFACTURING ACTIVITIES

The successful bidder will have to submit the bar chart for various Activities manufacturing activities clearly elaborating each stage, with quantity. This bar chart shall be in line with the Quality assurance plan submitted with the offer. The bar chart will have to be submitted within 15 days from the release of the order

18. SPARES, ACCESSORIES AND TOOLS of the order.

Bidder need to furnish the expected life of IEDs While submitting the Accessories and performance reports of the concerned IEDs. Bidders need to provide life cycle Tool support and supplies to ensure Necessary support in terms of services and spares for next 15 years regarding discontinuation OEM must need to follow clauses 3.15 & 6 of IEC 51850-4. The example cases should be taken as reference.

Vendor need to provide life cycle support and supplies to ensure necessary support in terms of services and spares for next 15 years from date of Purchase Order. Vendor shall provide expected life of IEDs in writing.

Vendor shall conform to the following guideline to mitigate failure, To provide immediate support in case of failureof IED. The vendor shall always maintain 2 Nos. of IEDs as spare at their India office/ TPCODL/TPNODL/TPSODL/TPWODL Office.

- Vendor shall report to site within 48 hours of receipt of reporting of the failure occurrence.
- Vendor shall provide replacement of the faulty IEDs within 7 days after confirmation of the fact that the IEDcan' t be repaired at site.
- Vendor shall provide detailed root cause analysis report of thefaulty IEDs within 30 days from the date of the IED receipt.
- Any spare IED replacement, testing and its commissioning to be done by vendor only without any cost implications. Any equipment, any software or any hardware to test the IEDs to be borne by vendor only.
- Any up gradation in application software and IED (except hardware) will be informed to us and necessary upgradation to be carried out by vendor without any cost implications.

Master Trip Relay (86) common for 66kV/33kV and 11kV	
No. of relays in Panels	No. of Spare relays
1-10	1
11-20	2
21-30	3
31-40	4

11-20	2
21-30	3
31-40	4

33kV/66kV panel				
No. of Panels	No. of Spare Relays			
	BCPU	Line PU	Transformer PU	
2 Line, 2 Trafo, 1 B/C	1	1	1	1
4 Line, 2 Trafo, 1 B/C	1	1	1	1
4 Line, 3 Trafo, 1 B/C	2	1	1	1
6 Line, 3 Trafo, 1 B/C	2	1	1	1
1 line, 1 Trafo, 1 B/C	1	1	1	1
2 line, 1 Trafo, 1 B/C	1	1	1	1

Spares for Project job for New Grids/Bay Extension

Services to be included during tender

i. Tri- party agreement to be made to have protection against quitting of executing vendor.

ii. In case total failure of IEDs during the warranty period exceeds 20% of the installed quantity of respective type at a particular station then vendor to configure these as some latent defect and configure replacement of all IEDs in TPCODL/TPNODL/TPSODL/TPWODL

iii. Preferably All the IEDs shall any external environmental its scope without any cost implication to have conformal coating to take care of polluting effect etc. TPCODL/TPNODL/TPSODL/TPWODL shall not be responsible if any such reason causes failure of cards/IEDs and each shall be vendor's responsibility to replace IED without any cost implication to TPCODL/TPNODL/TPSODL/TPWODL

19. DRAWINGS AND DOCUMENTS

Following drawings and documents shall be prepared on Purchaser's specifications and statutory requirements and shall be submitted with the bid:

- Completely filled in Technical Particulars
- General description of the equipment and all components including brochures
- Bill of material
- Type test certificates
- Hardware Specification
- Sizing Calculations of various component
- Standard Drawings
- ICD/CID Cite (IED capability description file)
- SCD file (substation configuration description)
- MIB Files of IEDS

After the award of the contract four (4) copies of drawings, drawn to scale, describing the equipment in detail shall be forwarded for approval and shall subsequently provide four (4) complete sets of final drawings, one of which Shall be auto positive suitable for reproduction, before the dispatch of the equipment. Soft copy (Compact Disk CD) of all the drawing, GTP, Test certificates shall be submitted after the final approval of the same to purchaser.

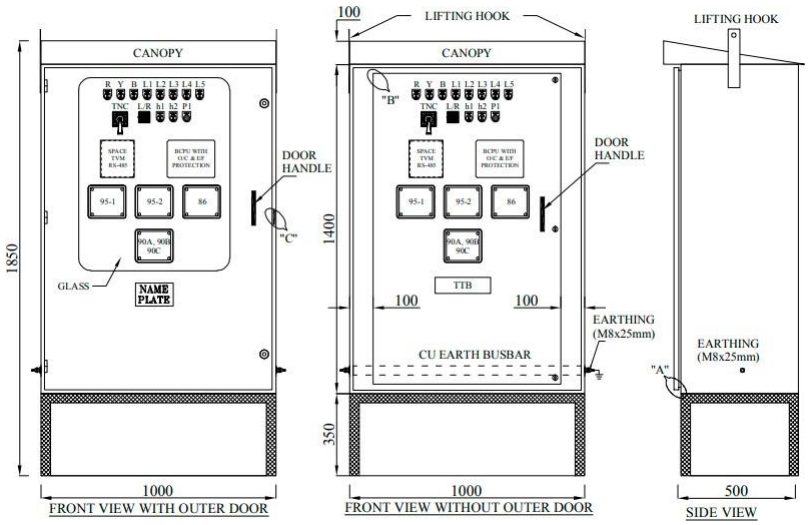
All the documents & drawings shall be in English language.
Instruction Manuals Bidder shall furnish two softcopies (CD) and four (4) hard copies of nicely bound manuals (in English language) covering erection and maintenance instructions and all relevant information and drawings pertaining to the main equipment as well as auxiliary devices.

20. SAMPLE DRAWING

(Dimensions subject to change during Detailed Engineering)

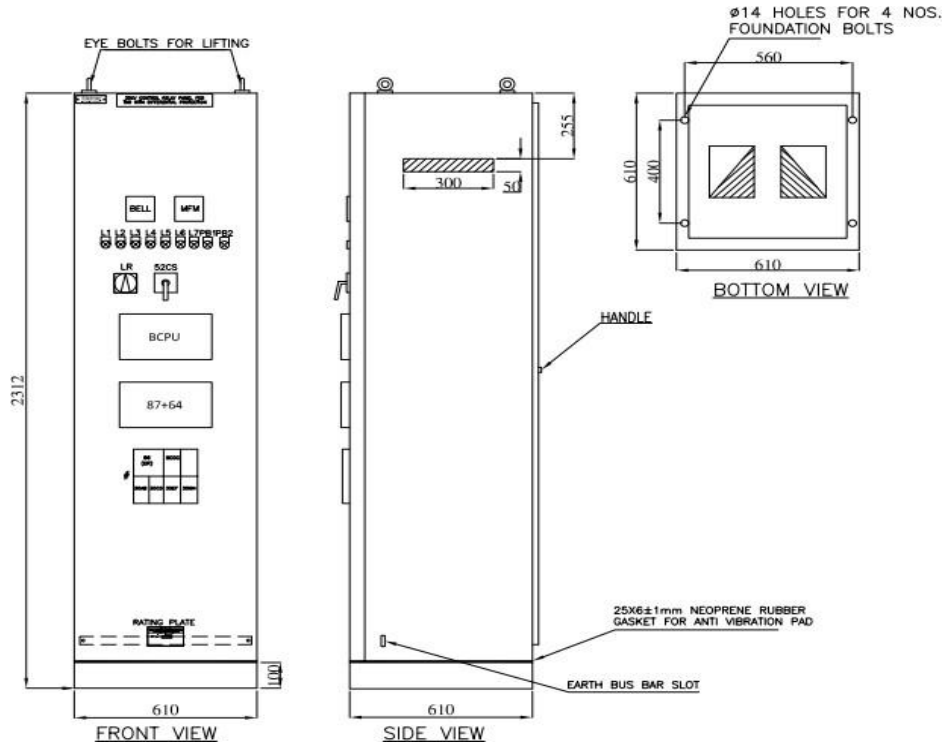
A. Outdoor CRP

(These are indicative drawing for Reference Purpose Only)



B. Indoor CRP:

(These are indicative drawing for reference purpose only ,will take double leaf rear door)



21. GUARANTEED TECHNICAL PARTICULARS

Bidder shall submit separate sheet showing compliances on all other clauses of the specification

22. SCHEDULE OF DEVIATIONS

(TO BE ENCLOSED WITH TECHNICAL BID)

All deviations from this specification shall be set out by the Bidders, clause by Clause in this schedule. Unless specifically mentioned in this Schedule, the tender shall be deemed to confirm the purchaser's specifications:

We confirm that there are no deviations apart from those detailed above.

S. No	Clause No.	Details of deviation with justifications

Seal of the Company:

Signature
Designation

Annexure-1

Following Points are to be considered for Indoor Control & Relay Panel.

i. Control & Relay Panel : Double leaf rear door to be considered for all the cases

ii. TTB: 3 Phase 4 wire front end connection 50A (DAV/IMP make) to be considered for TVM connection. Only space for TVM to be kept (TVM Dimension : 400x200x100 mm and is in TP Odisha DISCOM Scope) ,

iii. For CT : Disconnecting with shorting link to be included

iv. For TMU connection : Additional 70 No TBs to be considered (TMU shall be supplied by TP Odisha DISCOM)

v. IO List for 4 DISCOMs are different and shall be communicated during detailed engineering

vi. AC and DC MCB should be separate and to be separated by separator and each DC MCB should have add-on Contacts.

vii. DC MCB with add on contacts to be considered for each i.e. Closing coil , Tripping Coil 1 ,Tripping coil 2,BCPU Relay, Trafo Protection relay , MFM and Indications, TMU, Isolator, Lock out relay, Other relays if any.

viii. Preference of combi-flex /Ring Type Interface shall be decided during detailed engineering. For TPCODL it is preferred Ring type interface.

ix. LED Indication List as following :

a) Breaker OFF (Green)

b) Breaker ON (Red)

c) Auto Trip (Amber)

d) Spring Charge (Blue)

e) TC-1 Healthy (White)

f) TC-2 Healthy (White

x. High impedance Restricted earth fault scheme to be incorporated with resistor and metrosil for Trafo CR panel

xi. For transformer auxiliary relay NIFPS and SCADA contact need to be incorporated. (4 NO contact to be incorporated.)

xii. Transformer auxiliary alarm relay contact to be incorporated with Common alarm circuit.

xiii. Sequence of Mounting from bottom should as follows:

a) TTB & TVM

b) Auxiliary relay and Master trip relay

c) Numerical Relay (BCPU, 87T, TMU)

d) 52CS/ LR Switch /PTS for VCB and LR and TNC for Isolator Operation

e) Indication lamp

f) Bell

xiv. Cross ferruling need to be incorporated for all the control cable.

xv. Provision for Isolator Remote control from SCADA to be incorporated with auxiliary relay.

xvi. Suitable ratings of DC/AC MCB selections of preferred make (L&K,Eaton,ABB,Siemens,C&S,Legrand etc) and all the MCB should be of same make for aesthetic look .

xvii. BOs to be used for On/Off Command to be routed through CMR/IPR and suitable ratings of contactor to be selected for operating of VCB/Isolator.