



Specification No: ENG-GEN-4046

Specification Name: Technical Specification of
Substation Automation System for 33/11 kV
Primary Substations at TP Odisha Discoms

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**Tender Notification for SITC for Substation Automation System
for 33/11 kV Primary Substations
at TP Odisha Discoms**

Centralized Contracts Group

TP Central Odisha Distribution Limited

(A TATA Power and Odisha Government Joint Venture)

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Section – A

Project Specification

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1.0 Intent of Specification

TP Odisha DISCOMs (TPCODL/TPNODL/TPSODL/TPWODL) hereinafter called the "OWNER" or "PURCHASER", proposes to implement RTU based Automation System for its 33/11 kV Primary Substations to integrate with SCADA/ADMS System at the Purchaser's Main Control Centre (MCC) and Backup Control Centre (BCC) for remote monitoring and control. The proposed Remote Terminal Unit (RTU) shall communicate with the SCADA/ADMS System at MCC and BCC over IEC 60870-5-104 protocol for real time Monitoring & Control of the Switchgear/Switchyard and other accessories in the substation. The RTU shall be capable to acquire signal through hardwiring and communication (IEC 61850, IEC60870-5-103, IEC60870-5-104 and Modbus Protocol). The proposed RTU shall communicate simultaneously with Purchaser's minimum eight (8) SCADA System (redundant) over IEC 60870-5-104 with different network.

Bidder shall refer the entire project specifications to understand the execution methodology and interface equipment specification for the complete Scope of Work for this project. The bidder shall consider the entire scope of supply and services accordingly.

The document covers the specific requirements for complete design, detailed engineering, installation, testing and commissioning of

- a) RTU based Automation System
- b) Site survey related to the proposed project

This specification describes the technical requirements of the systems to be procured.

1.1 Introduction to TP Odisha DISCOMs

TP Odisha DISCOMs (TPCODL/TPNODL/TPSODL/TPWODL) are incorporated as a joint venture of Tata Power (51%) and Govt of Odisha (49%) on the Public-Private Partnership (PPP) model. Govt. of Odisha (GoO)'s share is held by its 100% owned company GRIDCO. TP DISCOMs took over the license of distribute electricity in the entire Odisha. TP DISCOMs' utility business is governed by the provisions of license issued by Hon'ble OERC for distribution and retail supply of electricity in Odisha.

1.2 General Information of TP Central Odisha Distribution Limited

Work is intended to be delivered across 4 Odisha DISCOMs i.e. TPCODL/TPSODL/TPWODL/TPNODL. There are approximately 1100 33/11kV PSS across 4 Odisha Discoms. Consumer of TPCODL, TPWODL, TPSODL and TPNODL are 3.1, 2.1, 2.3 and 2.1 million respectively.

1.3 Present SCADA & Substation Automation System

The new SCADA/ADMS System is implemented for all four TP DISCOMs distribution network. Under normal conditions, all the distribution network will be remotely monitored and controlled from MCC; however, in case of non-availability of MCC system, seamlessly the operation of entire primary and secondary distribution network will be transferred to BCC.

Currently integrated 33/11 kV Primary Substations are remotely monitored and Controlled from Centralized Power System Control Centre. Substations RTUs are integrated over LTE/IPMPLS/VPN communication network of the service provider (NBSP) with SCADA/ADMS system of MCC & BCC. The protection BCPUs of 33 kV and 11 kV feeders on IEC61850 in majority of the substation at 1 or 2 substations

over IEC60870-5-103, IEDs of Auxiliary Systems (i.e. FDS, Transformer Monitoring, AC & DC System, NIFPS, FRTUs (RMU) etc.) are integrated to the respective RTUs on IEC61850/MODBUS (Serial). The Digital Input/output (Status, Open/Close/Reset/Tap Change control, Protection Alarms) of the respective bays are acquired through the BCPUs. For monitoring of the Analog measurement, separate Multifunction Meters are used, which are integrated to the Station RTU over MODBUS (Serial) Protocol.

Sl. No.	Item Description	
1.0	Owner	TPCODL/TPSODL/TPWODL/TPNODL (A Tata Power & Odisha Govt. Joint Venture),
2.0	Consultant	Not Applicable
3.0	Location of the sites	Within the Operational Area/Distribution Network of TP DISCOMs
4.0	Connectivity	Sites are connected by road and Railways
5.0	Transport	Access roads are available for movement of materials to site. Movement of heavy materials would be through existing roads/rail up to TP DISCOMs Premises
6.0	Maximum Altitude above Sea Level	1000 Mtr.
7.0	Climatic Conditions	
7.1	Temperatures	
(a)	Maximum Ambient Air Temperature	50 Degree C
(b)	Maximum Daily Average Ambient Air Temperature	35 Degree C
(c)	Minimum dry bulb temperature	10 Degree C
(d)	Design temperature for Electrical / Electronic equipment / devices	65 Degree C
7.2	Relative Humidity	
(a)	Maximum During Monsoon	100%
(b)	Minimum During December	22%

(c)	Design Humidity	95%
7.3	Rainfall	Annual average rainfall is about 150 cm (most of which occurs during the monsoon season from June to September)
(a)	Average Number of Thunderstorm days per annum	70 (isokeraunic level)
(b)	Average Number of Rainy Days per Annum	120 days
7.4	Wind Velocity: 300 km/hr., 200 km/hr. and 160 km/hr. environmentally, some of the regions, where the work will take place includes coastal areas, subject to high relative humidity, which can give rise to condensation. Onshore winds will frequently be salt laden. On occasions, the combination of salt and condensation may create pollution conditions for electronic equipment. Some places are in heavily industrial polluted areas. Therefore, all supplied material and equipment shall be designed and protected for use in exposed, heavily polluted, salty, corrosive and humid coastal atmosphere.	
7.5	Seismic conditions	The proposed sites are in seismic zone III as per the Indian Standard IS 1893 and importance factor of 1.75
(a)	Earthquakes of an intensity in horizontal direction	Equivalent to seismic acceleration of 0.3g
(b)	Earthquakes of an intensity in vertical direction	Equivalent to seismic acceleration of 0.15g (g being acceleration due to gravity)
7.6	Air Quality	Atmosphere polluted with industrial gases and wastes because of proximity to industrial area.
8.0	Auxiliary Power Supply	
(a)	AC supply	230V, 1 phase, 2 wire, 50 Hz supply with one lead earthed shall be provided Voltage variation $\pm 10\%$, Frequency variation $\pm 5\%$ Combined voltage & frequency variation 10%
(b)	DC Supply	24V DC $\pm 10\%$ / 48V DC $\pm 10\%$, Sub Station DC System 24V / 48V Substation DC System will be used for Substation Automation System and its accessories.

2.0 Project Information

Project requirement shall be shared with BoM of the 4 Discoms in a separate annexure Annexure.

3.0 Scope of Work

The scope of this specification covers the technical and functional requirement with all accessories, tools and tackles of Design, Engineering, Supply, Insurance, Testing at Manufacturer's works, Packing, Forwarding, Transportation, Delivery at site, unloading at site/stores, material storage, Installation, Testing & Commissioning of Substation Automation System and its seamless integration with all Substation IEDs, Meters and with Purchaser's SCADA/ADMS Systems for the proposed Conventional Substations, comprehensive on site Warranty support for 5 years as per the detailed scope and specifications.

Any item though not specifically mentioned but is required to complete the project shall be considered and the same shall be supplied and installed by the bidder.

The indicative Bill of Material is attached with this document for bidder's reference and for bid purpose only (***Refer Annexure-7 of Section-E, Indicative Bill of Material for Proposed RTU based Automation System***). Attached BOM is indicative; Bidder shall submit the detailed BOM along with the offer, as per the System/Architecture offered to meet the specified requirements.

Bidder to note that the proposed system architecture shall give more emphasis on the following aspects

- a. Reliability
- b. High Availability
- c. Cyber Security Resilience

The project is proposed to be implemented in phased manner as per the scope mentioned in the RFP 33/11 kV Primary Sub-Stations in FY'25-26.

3.1 General

- a. It is in the interest of the bidder to visit the site(s), at his own cost, to assess the requirements before bidding for the project. Bidder may decide to visit all sites or sites on sample basis, with in the defined timelines as mentioned in Calendar of events.

After the placement of the award, the bidder ***shall carry out site survey of all Substations within a month from date of RC/RO***, to collect the required information for completion of detailed engineering. Bidder to note that any addition of the quantity required for sites during detailed engineering, will be in the scope of the bidder, with no commercial implication to TP DISCOMs.

- b. Bidder to note that any system (Hardware & Software) considered under this RFP for meeting the functional requirement shall be from the same OEM.
- c. ***No Hardware & Software shall be manufactured, delivered, customized exclusively for this Project/Contract.***

3.2 Engineering

- a. Based on the Site Survey, bidder to finalize the substation wise scope of work, BOM, Identification of the Contacts for Status, Protection and Control, Communicable IEDs, Availability of CT/PT for analog measurement.
- b. Finalization of Functional Design Specifications, Substation-wise Automation System Architecture, GTP, I/O List, Schematic Diagrams of Panel, Cable Requirement, Auxiliary Power System requirement.
- c. Preparation of Interconnecting Schedule (Field, Communication, Inter/Intra Panel)
- d. Layout finalization for installation of Panels, Cable route etc.

- Space available in the control room shall be utilized to house all the panels (RTU, Communication). Bidder to ensure optimal utilization of space to accommodate all the required equipment (i.e., RTU, Communication System).
- Appropriate IP class shall be considered for all the equipment planned under this project. IP class of the panel enclosure shall be IP54/55 as per the site requirement.

3.3 Installation & Commissioning

3.3.1 CRP

- Supply, installation and wiring of multipliers for providing potential free contacts for Digital Inputs such as status indication of Isolators, Breakers and others signal in the existing CRP/Field Marshalling Box as per "Indicative Signal List" (***Refer Annexure-4 of Section-E for Indicative Signal List***).
- Providing and mounting adequate copper lugs, TBs & Din rail channel of standard make in the CRP.
- Bidder to mount the CMRs with bases in CRP panel with proper arrangement i.e. segregated for Input, Output and Power Supply requirement. Mounting of TBs for the proposed scope shall not disturb the existing wiring and arrangement.
- The auxiliary contact used in CRP panel for Digital Inputs (Status and Protection) shall be used for contact multiplication to extend the same to proposed RTU. The other contact of the CMR shall be restored in the CRP for current application.
- Supply, Installation and Commissioning of the MFM in the CRP shall be in the scope of the Bidder. Bidder shall make appropriate cutout in the CRP panel for installation of MFM.
- Supply, Laying and Termination of power supply cable for extending 24V/48V DC inputs to the MFM in the CRP.
- All the MFM shall be looped for communication with the proposed RTU.
- Integration of IEDs through Ethernet/Serial Cable with RTU. Bidder to consider all networking accessories to connect station IEDs to all the proposed managed Ethernet switches.
- Integration of IED/BCPU on IEC61850 (Ed.1 &2) with the proposed RTU without additional hardware's.

3.3.2 RTU

- Data acquisition and Control is primarily planned through BCPUs***, therefore the integration of these BCPUs through ethernet switch and upto the RTU is in the scope of the bidder.
- In substation, where the data acquisition and control are not available through BCPUs, same will be achieved through CMR & HDR respectively.
- Supply, laying, wiring with proper termination of copper control cable for extending the status inputs from control panels (CMR output contact) to the RTU panel.
- Interposing Relay (Heavy duty Relay) shall be supplied and installed in the RTU panel along with wiring of the control cable to extend the control output of the RTU to CRP/Field panel.
- Analog output of WTI, OTI & TPI shall be connected with Analog input card of the RTU. Required instrumentation cable supplying, laying and termination is in the scope of the bidder.
- In some substations space for RTU panel shall be created by dismantling and shifting the existing unused dead panel by the bidder.
- Configuration of the RTU as per requirement, integration of the IEDs and Condition Monitoring devices of the Auxiliary System.

- h. Configuration of the Ethernet switches.
- i. The ITC cost is inclusive of any addition of Module/s in a RTU Rack for the Substations as per the site requirements.

3.4 Substation Earthing

- a. Bidder to submit the details of earthing requirement for the proposed solution.
- b. Providing of proper earthing to RTU and armored cable with separate Earth pit shall be in the scope of the Bidder.
- c. Earthing cable with proper sizing shall be laid from the RTU panel to the earth pits.
- d. Bidder to ensure maximum earth value of 2 Ohms.

3.5 Control, Instrumentation and Communication Cable

- a. For outdoor CRP, the bidder shall supply armored control cable and shall lay the cable through the cable trenches.
- b. The auxiliary contact used in CRP panel for Digital Inputs (Status and Protection) shall be used for contact multiplication to extend the same to proposed RTU panel.
- c. Supply, Laying and termination of control cable from RTU to CRP Panel for digital output.
- d. Supply, Laying, Wiring and Termination of control cable, multi-strand copper control cable for extending CT & CVT / PT inputs to the MFM in the CRP.
- e. Supply, Laying and termination of communication cable for IEDs and Condition monitoring devices and auxiliary system
- f. Supplying, Laying and Termination of auxiliary power supply cable for extending 24V/48V DC inputs from DCDB to the MFM in the CRP. All the MFM shall be looped to the RTU panel for communication with the RTU.
- g. All the MFM shall be looped to the RTU panel for communication. Looping from MFM to MFM shall be done from MFM to the terminal block and subsequently terminal block to terminal block in the panel.

3.6 Panel Erection

- a. Appropriate civil work shall be carried out before installation of RTU panel.
- b. Nuts and bolts shall be properly fastened to fix the panel on the floor.
- c. Appropriate IP class shall be considered for all the equipment planned to be installed in indoor applications. For indoor application bidder shall consider panel enclosure with IP54 or better as per the site requirement.
- d. In some substations space for RTU shall be created by dismantling and shifting the existing unused dead panel by the bidder.

3.7 Communication Infrastructure

- a. Communication components and accessories such as Converters, Serial Server, Ethernet switches, and other accessories such as cables, connectors etc. required for the RTU based automation systems shall be in the scope of the bidder.
- b. Installation of Ethernet Switches, Media converter (if required), communication cable supply, laying, termination is in the scope of the bidder for the RTU based automation system supplied at conventional substations to meet all the functional requirement specified in this RFP.

- c. Communication equipment's like Router cum Firewall, POE and its associated power supply and any other accessories required to make through the communication between RTU and IPMPLS cloud shall be installed in the RTU panel. Bidder to take care during detailed engineering. However, supply of these equipment's except the communication cable shall not be in the scope of the bidder.
- d. Installation of communication network equipment, communication establishment, cable supply, laying, termination is in the scope of the bidder for the Substation Automation system to meet all the functional requirement specified in this RFP.

3.8 Integration

- a. Configuration of the RTU and Communication Systems as per RFP shall be carried out by the Bidder followed by Local Testing, Pre-SAT and SAT.
- b. During local testing (Pre-SAT) each Digital Input, Digital output and Analog Inputs shall be tested with the RTU, by simulating at switchgear end with satisfactory result. Each MFM data shall be verified with RTU after integration over Modbus protocol.
- c. RTU configuration shall be tested completely in all respect so that integration testing shall be carried out smoothly without any technical issues during point-to-point testing with Purchaser's SCADA Systems. However, the necessary configuration at the Control Centre end shall be taken care by the Purchaser.

3.9 Cyber Security Audit

- a. Bidder to carry out Cyber Security Audit by Third Party Auditor for 10% of the PSS covered under each Release Order of the TP DISCOMs.
- b. Cyber Security Audits shall be mandatorily conducted by CERT-IN Certified Third party Auditor.
- c. Bidder to propose minimum 5 Nos. Auditors from empaneled information security auditing organization of CERT-IN, and having an experience of conducting Audit of Operational Technology System (SCADA/ADMS, Grid Substation Automation System). M/s TP DISCOMs reserve the right to select any one/two among them basis on credential of the Auditor Organization and experience of conducting such Audits.
- d. Security audits is to be conducted in line with requirements from IEEE 1686, IEC 62443, NERC_CIP, ISO 27001 and IEC62351 standard
- e. Gap Analysis / Vulnerability Assessment (VA) – Auditor needs to identify the vulnerabilities present in the substations automation system implemented at the substation by bidder.
- f. Security Controls Implementation - Based on the results of VA, Bidder needs to fix all the gaps identified during Cyber Security Audit within a Month.
- g. Bidder to get re-certification from the Auditors for the Cyber Security Compliance from the third party auditor after fixing the gap within a month.
- h. Bidder to submit the Third Party Auditor report for DISCOMs review and record.
- i. Cyber Security Audit shall include all the system installed at Substation (Bidder's OWN and System Installed by P DISCOMs) the following indicative/tentative List of Equipment in the substation is mentioned below–
 - IEDs - BCPU, DC System Controller, TMU, RTU, FDS, Engineering Laptop etc.
 - Networking Equipment – Ethernet Switches, Firewalls, Routers, GPS receiver, etc.
 - Configuration software of RTU, BCPU, FDS, DC System Controller etc.

- Other software components – Operating system, MS Office applications, Adobe, SQL, JAVA, Antivirus etc.

3.10 Safety

- a. Bidder to adhere mandatorily the safety guidelines and policy of TP DISCOMs. Bidder shall refer the Safety document attached with this bid document.

3.11 Documentation, Backup

- a. Bidder shall provide all documentation in soft / hard form about licensing information for each software supplied (OS, Application Software, Configuration, Diagnostics, Simulation & Testing tools). ***(Please refer Section D, Drawings & Documents)***
- b. The Documents shall be submitted as proposed. Master Document List (MDL) shall be prepared by Bidder and submitted for Purchaser's approval.
- c. The offered system shall store the copy of the system configuration, user configurable database, tools and relevant software as a backup at Purchaser's identified location for restoration under a disaster recovery plan.
- d. The bidder shall provide complete engineering data, drawings, reports, manuals and services offered etc. i.e. complete set of documentation / drawings / architectures/ Inter-Operability Tables (IOTs) submission of Test Reports, job progress reports etc.
- e. It is the responsibility of the Bidder to handover all project related drawings in AutoCAD formats only. The pdf version of above drawings / documents shall also be submitted for formal approval process.
- f. Submission of technical documentation related to design, installation, testing, operation & maintenance of the equipment and submission of Test Reports, job progress reports etc. in hard copies (3 sets) and soft copies (3 sets, preferably in PDF).
- g. Providing complete source code, including customization

3.12 Training

- a. Training of Purchaser's Personnel at site with all required training setup for each individual trainee. ***(Please refer Section A, Item 15.0 for Training requirement)***

3.13 Mandatory & Recommended Spares

- a. Supply of recommended and mandatory spares for all supplied items ***(Please refer Section A, Item 17.0 for Spares Requirement)*** as mentioned in the separate section.

Bidder shall refer the entire project specifications of the RFP to understand the execution methodology, supply, services and interface requirement for complete Scope of work of this project.

It is not the intent of this specification to specify completely herein, all details of design & construction of the proposed System. However, the bidder is encouraged to provide latest hardware and software technology used worldwide to meet the specified requirement and at the same time system shall conform in all respects to high standards of engineering, design & workmanship as per the functional requirement mentioned in the RFP.

4.0 Terminal Points

4.1 Bidder

- 4.1.1 Site Survey, BOM and Scope finalization, Engineering, Preparation of Architecture, Layout, ICS and other documents Substation wise covering all the functional requirement envisaged by the Purchaser and documented in the RFP.
- 4.1.2 Supply and Installation of RTU and other offered systems.
- 4.1.3 Integration of the existing system field devices and hardware signals (IEDs, MFM & hardware signals) to proposed RTU based Automation system. Supply of the required material including cables, erection, installation, cable laying & termination, database and logic development, FAT, pre-SAT testing, SAT and demonstration of the required performance is the sole responsibility of the bidder.
- 4.1.4 The offered product shall comply to all open protocols used in electrical substation application such as IEC60870-5-xxx, IEC61850 (ED1, ED2), Modbus, Serial and TCP/IP etc. and compatible with all other OEMs product. Any interoperability issues arising during commissioning and during guarantee period, bidder shall undertake to resolve them within maximum 1 months' period without any additional cost to the Purchaser.
- 4.1.5 Provision of the required power supply from ACDB, DCDB. It is the bidder's responsibility to lay the required cable up to the equipment supplied by bidder and further make the provision to distribute for the systems supplied under this contract.
- 4.1.6 Suitable separate Earthing system (including earth pit) for offered system
- 4.1.7 Integration with Control Centre SCADA Systems as specified in the specifications
- 4.1.8 Bidder shall depute adequate manpower, resources and material to complete the project as per the schedule mentioned in the RFP. If Purchaser feels that the adequate resources and material are not provided, reserves the right to ask the bidder to supply the required material and depute additional resources to complete the project in time.
- 4.1.9 There shall be only one point of contact for Purchaser, i.e. the bidder who will be awarded the contract will be responsible for delivering the project solely. Any Sub-Contracting of any part of the work will be the responsibility of the lead Bidder as specified by Purchaser.
- 4.1.10 All application software, hardware, data, plans, drawings, specifications, designs, reports and other documents procured or developed by the selected Bidder in the execution of the contract shall remain the property of the Purchaser, right from the beginning of the contract, during the whole duration of the project and after the expiry or termination of the contract. Purchaser shall also remain the sole owner of the property (Hardware/software) in case the contract is terminated for any other reason. The source code/Application of the customized part of the application software in RTU will remain as exclusive property of Purchaser, even after the termination or expiry of the contract. The ownership shall also remain with Purchaser in case the selected Bidder fails to execute tasks to the satisfaction of the Purchaser.
- 4.1.11 Any deviation from this RFP / Technical Specification or as per the requirement of Purchaser, if noticed, may be brought forth in the Bid offer / pre-bid meeting / meeting before award of contract. Any such deviation, if informed thereafter bidder will supply Hardware and Software as per the site and functional requirement free of cost to the Purchaser. The decision of Purchaser will be final.
- 4.1.12 The selected bidder, after award of contract, will finalize the actual quantities to be deployed based on site survey, after approval from Purchaser, before initiating the purchase process of such items. All the hardware and software shall be procured and delivered after taking prior approval of Purchaser for each consignment. However, if any change in the quantity of the material, there should not be any additional cost to the purchaser.
- 4.1.13 Engineering and technical assistance during the contract and standard warranty and maintenance period.
- 4.1.14 Provide calculation for power requirement for each cabinet and equipment

- 4.1.15 Bidder to submit all the purchase order placed on Sub-vendor to TP DISCOMs for their review and records.
- 4.1.16 Maintaining backup of all RTU configuration for all substations and handover the same in duplicate to Purchaser.
- 4.1.17 Provide a Quality Assurance Plan and access to the manufacturing process.
- 4.1.18 The bidder shall provide all additional equipment and services required to ensure compatibility with Purchaser's systems.
- 4.1.19 The bidder shall demonstrate a specified level of performance of the system during FAT & SAT.
- 4.1.20 Bidder shall submit the project plan with major milestone prior to the start of the execution of the project.
- 4.1.21 Bidder must agree for handing over, to Purchaser, all project related drawings in AutoCAD format as a part of as built drawings at the end of the project in addition to pdf. The pdf versions of above drawings shall be submitted for formal approval process during detailed engineering.

4.2 Purchaser

- 4.2.1 Will assist the bidder to provide the necessary work permits for working in operational area
- 4.2.2 Participation of Purchaser's engineers during RTU Engineering & Configuration, however bidder shall be responsible for validation of this database.
- 4.2.3 Providing all the necessary data regarding the electrical network
- 4.2.4 Providing details of the existing systems for specified integration
- 4.2.5 Review and Approval of IP Schema for all the IEDs, RTU, in-line with existing System
- 4.2.6 Providing communication backbone for interconnection with existing systems
- 4.2.7 Review and approval of the Bidder's designs, drawings, and recommendations
- 4.2.8 Review and approval of test procedures
- 4.2.9 Participation in and approval of "Type", factory and site acceptance tests
- 4.2.10 Review and approval of training plans.
- 4.2.11 Coordination of the Bidder's activities with the Purchaser's concerned departments

5.0 Exclusions

The Bidder shall be responsible for providing all the hardware and software, RTU Engineering /Configuration and services required for commissioning of project except mentioned below

- 5.1 Buildings
- 5.2 Air Conditioning
- 5.3 Fire Fighting/Detection system

But Bidder must indicate the optimal space requirements for systems/panels/equipment being supplied under this project, so that entire substation infrastructure can be installed in the available space as per the space availability at each site.

6.0 Instruction to Bidders

6.1 Bidder Confidentiality

All information contained in this specification is confidential and shall not be disclosed, published, shared or advertised in any manner without written authorization from Purchaser, includes all bidding information submitted. All specification, data and documents submitted by bidder remain the property of Purchaser and all bidders are required to return these documents to Purchaser upon request. Bidders who do not honor these confidentiality provisions will be excluded from participating in future bidding events.

- 6.1.1 Information relating to the examination, clarification, evaluation and comparison of Bids and recommendations for the award of a contract shall not be disclosed to Bidders or any other persons not officially concerned with such process. Any effort by a Bidder to influence the Purchaser's processing of Bids or award decisions may result in the rejection of the Bidder's Bid.
- 6.1.2 Prior to the detailed evaluation, Purchaser will determine the substantial responsiveness of each Bid to the Bidding Documents including production capability and acceptable quality of the Goods offered. A substantially responsive Bid is one, which conforms to all the terms and conditions of the Bidding Documents without material deviation.
- 6.1.3 Bid determined as not substantially responsive will be rejected by the Purchaser and/or the Purchaser and may not subsequently be made responsive by the Bidder by correction of the non-conformity.
- 6.1.4 The Bid prepared by the Bidder, and all correspondence and documents relating to the Bid exchanged by the Bidder and the Purchaser, shall be written in the English Language. Any printed literature furnished by the Bidder may be written in another Language, provided that this literature is accompanied by an English translation, in which case, for purposes of interpretation of the Bid, the English translation shall govern.
- 6.1.5 Bidders shall quote for the entire Scope of Supply / work with a breakup of prices for individual items and Taxes & duties. The total bid price shall also cover all the Bidder's mentioned in or obligations mentioned in or reasonably to be inferred from the bidding documents in respect of Design, Supply, Transportation to site, all in accordance with the requirement of bidding documents. The bidder shall complete the appropriate Price Schedules included herein, stating the Unit Price for each item & total price with taxes, duties & freight up to destination at various sites of Purchaser. The prices offered shall be inclusive of all costs as well as Duties, Taxes and Levies paid or payable during the execution of the supply work, breakup of price constituents.
- 6.1.6 The quantity breakup shown else-where in Price Schedule is tentative. The bidder shall ascertain himself regarding material required for completeness of the entire work. Any items not indicated but are required to complete the job, shall be deemed to be included in prices quoted.
- 6.1.7 The bidder is not allowed to modify or withdraw its bid after the Bid's submission.
- 6.1.8 The Principal & their Indian Representative shall be responsible jointly and severally for the design, supply, erection, commissioning & satisfactory performance of the supplied system and specified standard Warranty Maintenance, Activities and support. The Principal shall also vet the design and participate in the engineering, commissioning at site, Acceptance Tests & Training. The Indian Representative shall have full facilities for design, Supply, erection, commissioning, system integration, factory and site acceptance test, satisfactory performance of supplied system and specified post warranty maintenance. Please refer the qualifying requirement for more details.
- 6.1.9 Bidder/Principal shall demonstrate required functionality and capability in Purchaser's office during technical evaluation before bid submission
- 6.1.10 In case of agreement dishonored by any party (Bidder/ Principal), during life of the delivered system, Principal shall be responsible for providing the services to the Purchaser. Bidder/ Principal shall submit the address and contact details of the Principal's Purchaser account holder.

- 6.1.11 The Bidder (including Principal) shall give an undertaking to provide full range of services (including hardware and software maintenance, modifications, and upgrade support) for the life of the delivered RTU system and other sub-vendor equipment and services.

6.2 Type Tests Reports

The type tests specified in Purchaser specifications should have been carried out within five years prior to the date of opening of technical bids and test reports are to be submitted along with the bids. If type tests carried out are not within the five years prior to the date of bidding, the bidder will arrange to carry out type tests specified, at his cost. The decision to accept/ reject such bids rests with Purchaser. Type test reports should be issued by third party government accredited laboratory or internationally recognized laboratory like NABL / CPRI / ERDA / KEMA / International Accredited Lab.

6.3 Technical Clarifications

TP DISCOMs do not entertain any deviation on the project specifications. The bidder should submit declaration on no deviation. However, if there are any deviations the Bidder should bring in notice of the Purchaser with proper documentations justifying the deviation. The Purchaser will take a call after going through the document and the decision of the Purchaser will be final. No explanation shall be provided to the Bidder for that. After scrutiny of qualifying criteria, technical commercial criteria offered by the bidder, clarifications will be sought from the bidders for any deviations with respect to the Purchaser specifications and attempt will be made to bring all bids on a common platform.

6.4 Bid Evaluation Criteria / Bid Selection / Bid Award Decision

- 6.4.1 The decision to place purchase order/LOI solely depends on Purchaser on the cost competitiveness across multiple lots, quality, delivery and bidder's capacity. In addition to other factors that Purchaser may deem relevant.
- 6.4.2 Purchaser reserves all the rights to award the contract to one or more bidders to meet the delivery requirement and timely project completion as per TP DISCOMs policy or nullify the award decision without any reason.
- 6.4.3 In case any Bidder is found unsatisfactory during the delivery process, the award will be cancelled and penalized for non-execution of the project in time. In addition, the Purchaser may downgrade the rating of the Bidder which will affect the future businesses/opportunities with TP DISCOMs.

6.5 Climate Change and Waste Management

Significant quantities of waste are generated during the execution of project and an integrated approach for effective handling, storage, transportation, and disposal of the same shall be adopted. This would ensure the minimization of environmental and social impact to combat the climate change.

It is bidder's responsibility to transport and shift all the waste material generated to Purchaser's designated location for further disposal/processing.

6.6 Ethics Policies, Mandates and Considerations

Purchaser is a most ethical organization and as a policy Purchaser lays emphasis on ethical practices across its entire domain. Bidder should ensure that they should abide by all the ethical norms and in no form

either directly or indirectly be involved in unethical practices. Bidder is advised to refer GCC attached for more information.

6.7 Safety Considerations

Safety related requirements as mentioned in our safety Manual. All Partners/Associates shall strictly abide by the guidelines provided in the safety manual at all relevant stages during the contract period. Bidder is advised to refer GCC attached for more information.

- a. All the equipment shall be as per IEC / IS standards.
- b. As the work has to be carried out in operational area, necessary work permit shall be prepared and approved from authorized persons.
- c. While working on site, use of PPE (personal protective equipment) is mandatory.
- d. Installation and commissioning of equipment, laying of cables activities shall be done by adequately trained persons with proper procedure including required outages of equipment/system.
- e. Bidder shall furnish operating and maintenance manuals clearly bringing out safety aspects of equipment.
- f. Bidder's all site persons have to go through Safety Training at Purchaser's site
- g. Bidder to depute Safety officer, to ensure the activities at site during installation and commissioning of the system as per Purchaser's safety policy and procedures.
- h. The Bidder's safety officer shall work along with Purchaser's Safety officer as per the policies and requirement stated in the Safety document.

6.8 Bidder's Technical and Commercial Proposal

6.8.1 General Guideline

- a. Purchaser will select the 'bidder' in accordance with the eligibility criteria indicated in **Item 8.0** of this document.
- b. The bidders are invited to submit a Technical Proposal and a Commercial Proposal for goods and related services required for the project as defined in RFP. This proposal will be the basis for finalization of the contract with the successful bidder.
- c. The bidders must familiarize themselves with local conditions and take these into account while preparing their proposals. To facilitate the bidders in making the Proposal, the Purchaser shall have a 'Pre-Bid Discussion/meeting as per the schedule mentioned in RFP.
- d. Please note that costs involved in preparation of the proposal and of negotiating the contract, including a visit to the Purchaser, are not reimbursable.
- e. Bid prices shall be quoted in Indian Rupees only.

6.9 Risk & Mitigation Planning

Bidder shall assess underlying risks in implementation of the Project and detail out the methodology to mitigate them. It may include development of a risk assessment matrix indicating severity of the risk, chance of its occurrence and its mitigation approach.

7.0 Codes and Standards Applicable

The design, manufacture and performance of the RTU System shall comply with all the requirements of the latest editions of international codes and standards applicable. Nothing in this specification shall be construed to relieve the Bidder of this responsibility.

Emissions Standards

1	EN55011 (CISPR 11)	ISM RF Equipment – Electromagnetic Disturbance Characteristics
2	60255-25	Electromagnetic emission tests for measuring relays and protection equipment
3	61000-3-2:2000	EMC-Limits for harmonic current Emissions.
4	61000-3-3:1994+2001	EMC Limits-Limitations in voltage changes, voltage fluctuations and flicker in public low-voltage supply systems.

Immunity Standards

1	61000-4-2 1995-01 60255-22-2, IEEE C37.90.3	Electrostatic discharge (ESD) immunity test
2	61000-4-3 1998-11, 60255-22-3 IEEE C37.90.2 (10V/m)	Radiated, radio-frequency electromagnetic field immunity test
3	61000-4-4 1995-01 60255-22-4 IEEE C37.90.1	Electrical fast transient/burst immunity test
4	61000-4-5 1995-02	Surge immunity test
5	61000-4-6 1996-03	Immunity to conducted disturbances, induced by radio-frequency fields
6	60255-22-6	Electrical fast transient/burst immunity test
7	61000-4-8 1993-06	Immunity to power frequency magnetic fields
8	61000-4-12	Oscillatory waves immunity test
9	1995-05, 60255-22-1,	(Damped Oscillatory and Ring wave)

	IEEE C37.90.1	
Safety		
1	61010-1	Harmonized Safety Standard
2	60255-5 2000-12	Insulation coordination for measuring relays and protection equipment- Requirements and tests
Power Supply Standards		
1	61000-4-11 1994-06	AC Power supply interruptions
2	61000-4-16 1998-01	Immunity to conducted, common mode disturbances.
3	61000-4-17	Ripple on D.C. power supply
4	61000-4-29+ 2000-08 60255-11	Voltage dips, short interruptions & voltage variations on D.C. input power port immunity test
Environmental Standards		
1	60068-2-1 1994-05	Environmental Testing Cold
2	60068-2-2 1974	Environmental Testing Dry Heat
3	60068-2-6 1995-03 60255-21-1	Environmental Testing Vibration tests (sinusoidal)
4	60068-2-27 1987	Environmental Testing Shock
5	60068-2-29 1987	Environmental Testing Bump
6	60068-2-30 1980	Environmental Damp Heat cyclic (12+12 hour cycle)
7	60068-2-31 1969	Environmental Testing Drop and Topple
8	60255-21-2	Shock and bump tests
9	IEC 61850-3	Substation Environment Requirement
Communication Standards		

1	IEC 61850-5 to 10 IEEE 802.3 CSMA/CD	Substation Comm. Standard access method and physical layer specifications
Other Applicable Standards		
1	IS 9000	Basic Environmental testing procedure for electrical and electronic items
2	IS 694-1990	PVC insulated cables for working voltage up to and including 1100V
3	IS 2629-1985	Recommended practice for Hot Dip Galvanizing of iron & Steel.
4	IS 2633-1986	Test for uniformity of Zinc Coating
5	IEC 60529	Degrees of Protection provided by enclosures (IP Code)
6	IEC 62052-11	Electricity metering equipment (a.c.) – General requirements, tests & test conditions
7	IEC 62053-22	Static meter for active energy (Class 0.2S and 0.5S)
Product Conformance as per GoI Letter No. 12/34/2020-T&R dated 8th June 2021, Ministry's Order No. 25-17/6/2018-PG dated 2nd July 2020		
1	• IEC 60870-5-101 & IEC 60870-5-104, Security Conformance • IEC 62351-100-1: <i>Clause 5, Clause 6, Clause 7, Clause 8</i> • IEC 62351-100-3: <i>Clause 5, Clause 6, Clause 7</i> (IEC 62351-3:2014 / AMDI: 2018, Clause 7), • IEC TS 62351-5/IEC TS 60870-5-7	IEC 60870-5-7 Telecontrol equipment and Systems – Part 5-7; Transmission protocols – Security extensions to IEC 60870-5-101 and IEC 60870-5-104 protocol (Applying IEC 62351) IEC 60870-5-7 Security extension & IEC 62351 series (IEC 62351-100 parts 1 & 3) and other cross-referenced standards. IEC 61850 – 5, 6, 7, 8, 9, 10 Certificate of Common Criteria as per ISO/IEC 15408

Wherever, new standards and revisions are issued during the period of the contract, the Bidder shall attempt to comply with such standards, provided there is no additional financial implication to Purchaser.

In the event of the bidder offers to supply material and/or equipment in compliance to any standard other than those listed herein, the bidder shall include with their proposal, full salient characteristics of the new standard for comparison.

8.0 Bidder's Qualification Requirement, Experience, Evaluation Criteria

8.1 Bidder's Qualification Requirement

- 8.1.1 The Bidder shall be OEM or Authorized Channel Partner. OEM's Authorized channel partner shall submit the MAF & OEM letter
- 8.1.2 The Bidder must have a presence in India for last 5 years, meeting requirement as specified below:
 - a. Registered in India under the Companies Act of India, as on Techno-Commercial Bid submission date for supply of the Sub-Station Automation System.
 - b. The Bidder should not be blacklisted by any Organization.
 - c. Having experience and infrastructure to carry-out in-house Design, Engineering, Supply, Erection, Commissioning, Routine & Acceptance Tests, Service Support during Warranty period, Training facility of Sub-Station Automation System in India.
 - d. In case Bidder is the authorized distributor of OEM, the OEM shall be responsible jointly and severally for the design, supply, erection, commissioning & satisfactory performance of the supplied system and specified Post Warranty Maintenance.
- 8.1.3 At least 100 Nos. RTUs commissioned and integrated with SCADA & ADMS system for Power Utility during the last five (5) years.
- 8.1.4 Bidder to submit performance certificate of projects with one project with 50 Nos. of RTUs or two projects with 25 Nos. RTUs which is running in satisfactory condition for last two (2) years.
- 8.1.5 The bidder shall submit Type test reports obtained from CPRI / ERDA / KEMA / International Accredited Lab for the offered solution. The type tests should have been conducted on the equipment / material of the same design.
- 8.1.6 In case the type test reports furnished are not for the offered equipment / material but for the equipment / material with and/or different capacity, then type test shall be carried out for the offered equipment / material from CPRI / ERDA / KEMA / International Accredited Lab without any cost implication to the Purchaser and the Type Test reports shall be submitted before dispatch of the equipment / material.
- 8.1.7 Equipment, Spare Support and Availability of the proposed system will be for the period of minimum 10 years.

8.2 Bidder's Project Experience

- 8.2.1 Bidder shall provide details of projects with application modules and other requirements Eligibility Criteria which have been successfully completed during the last 5 financial years. Please do not supply the names of clients who are no longer using your product/system. Bidders need to submit the details as per the format in the table provided and necessary supporting documents should be attached with RFP:

Sl. No.	Name of the Project	Client Name and Contact Details	Whether the Project was successfully commissioned	Date and Year of Commissioning	Value of the Project	Indicate the RTU with modules implemented in the project	Indicate the integration with SCADA System	Indicate whether interface was included in the project? If Yes, please	Indicate the protocol implemented viz IEC60870-5-101/104, IEC61850, Modbus (IP, Serial)

Table: Details of Project Experience

Note: Kindly provide Client Performance Certificates for the completed projects provided for establishing/confirming the requisite details for project experience as mentioned above Or Copy of LoA/ Work Order along with proof of release of final payment.

- 8.2.2 The Bidder should have at least 20 personnel on its roles with a minimum experience of 5 years on RTU based substation automation Engineering, Application and Commissioning . Experience should includes Communication System, Cyber Security, IoT etc. Signed resume of employees authenticated & signed by the bidder needs to be submitted. Scanned signatures of the employees shall be accepted.
- 8.2.3 The offered product shall comply to all open protocols used in electrical substation application such as IEC60870-5-104, IEC61850 (ED1, ED2) Client, Modbus, Serial and TCP/IP etc. and compatible with all other OEMs product. Any interoperability issues arising during commissioning and during guarantee period, bidder shall undertake to resolve them within maximum 1 months' period without any additional cost to the Purchaser.
- 8.2.4 Product shall confirm to Cyber Security norms from product development, design and engineering for Power Utility, compliance to industry standard NERC-CIP, IEC62443, NIST and IEC62351.
- 8.2.5 Bidder shall agree to comply with minimum quality requirements and Contractor Safety Code of Conduct, defined in bid documents.
- 8.2.6 Bidder must agree for handing over, to Purchaser, all project related drawings in AutoCAD format only. The pdf versions of above drawings shall be submitted for formal approval process.
- 8.2.7 Bidder shall submit the acceptance of TP DISCOMs preferred list of Vendor / Sub Vendor / OEM, which is shared as part of Technical Specifications and the same shall be acceptable to the bidder. **(Refer Annexure-6 of Section-E, Preferred/Approved make of Equipment/System).**
- 8.2.8 Bidder shall confirm the equipment and Spare Support and Availability for the period of 10 years. Bidder shall submit each equipment product life cycle details along with the technical proposal (for Own and Sub Vendor Equipment).

The bidder may avail credentials of its parent company for fulfillment of eligibility criteria as mentioned above.

8.3 Bid Evaluation Criteria

- 8.3.1 The Bids will be evaluated technically (in terms of quality, technical merit, functional characteristics, schedule, after-sales service, local support in India and technical back-up). The technical merits and quality and functional characteristics of the offered equipment and work will be evaluated in terms of its ability to meet specific technical requirements included in the Contract Documents. The Bidder shall therefore

be prepared to submit at the request of Purchaser adequate information or Work meets the intent of the technical requirements.

8.3.2 Purchaser shall be fully entitled to adopt whatever means it deem fit to evaluate the bids at its sole discretion, which shall not be questioned by the bidder under any circumstances whatsoever.

8.3.3 The evaluation team will thoroughly review the proposals submitted by various bidders. The broad technical evaluation will be based as below

- a. Technical Proposal: 100% Weight
- b. Pre-bid meetings will be conducted with all the bidders

Minimum qualification mark for technical score as mentioned in the RFP shall be 80 out of 100.

8.3.4 Technical Evaluation

The technical bid has a weightage of 100%. Technical evaluation will happen in two stages.

- a. **Stage-1: Preliminary Evaluation**

In Stage-1, the following shall be confirmed: Deviations, Acceptance of terms and conditions, Acceptance to scope of work and compliance to technical specification (***Scope of work as mentioned in Section A and technical details in Section B***). In case the bid doesn't meet all the mandatory requirements, the bid shall be termed as non-responsive and will not be evaluated further.

- b. **Stage-2: The distribution of weights for bid-evaluation are as follows**

Sl. No.	Description	Weight	
A	Technical Proposal		100
1	Project Experience	40	
2	Presence in India	10	
3	Team Details (CV)	20	
4	Technical Know-How	30	
	Total Marks		100

Sl. No.	Description	Max Score
	Technical Solution Score	100
1	Project Experience	40
a)	Number of RTU Based Automation projects successfully completed in last 5 years. Similar to Technical Requirements as per the specification	15

	10 marks shall be awarded for a single project meeting the functionality as mentioned in the QR. - In case 2 projects 25 Nos. RTU each are submitted, 5 marks shall be awarded for each project. - Satisfactory performance certificates of the running projects 5 marks shall be awarded for RTU integration with multiple OEM's protection, control and condition monitoring devices (like DC System Controller, Fire Detection System, Transformer Monitoring System, Weather Sensor etc.) on industry standard protocol.	
b)	Project experience in implementation of RTU based Automation Systems having similar solution	25
	Bidder having experience in satisfying the following criteria: - Execution of SCADA Enablement project in Conventional Types of substations (5 Marks) - RTU integration over IEC 60870-5-104 protocol with multiple OEM's SCADA Systems. (4 marks) - Experience on implementation of Cyber Security measure in Sub Station Automation (RTU, IEDs etc.) (4 marks)	
	Project Experience in RTU Commissioning (4 marks)	
	a) IED integration with RTU over IEC 61850 (ED1 & latest ED2), implementation of logic using GOOSE in RTU b) Integration of multiple OEM IEDs over MODBUS (RTU, TCP/IP),	
	Project experience in integration of Renewable Energy System (Solar, Battery Storage) (4 marks)	
	The bidder shall be awarded marks indicated for satisfying the above criteria in one project or multiple projects put together. For satisfying of single criteria, only indicated marks shall be awarded, irrespective of its implementation in number of projects.	
2	Presence in India	10
	a) Manufacturing in India as an initiative of Government of India "Make in India"; 3 Marks	3

	b) The bidder with design, Engineering, Testing, Installation, Commissioning, Maintenance, Patch Management, Timely Upgradation facility in house (In India) as on date of release of RFP; 7 Marks	7
	Team Details (CVs)	20
3	Experience minimum 5 years in area of RTU based Automation Systems Design & engineering based on IEC 61850 (Ed.1 & Latest Ed.2), IEC60870-5-103, IEC 60870-5-104, Modbus RTU & TCP etc. For submission of CV, 1 mark shall be awarded per CV subject to ceiling of 5 marks that can be obtained in this category.	5
	Experience minimum 5 years in area of Control and protection systems engineering and commissioning in power distribution application. For submission of CV, 1 mark shall be awarded per CV subject to ceiling of 5 marks that can be obtained in this category.	5
	Experience minimum 5 years in area of RTU integration with SCADA systems on IEC 60870-5-104, Cyber Security and Communication Networking. For submission of CV, 01 mark shall be awarded per CV subject to ceiling of 5 marks that can be obtained in this category.	5
	Experience minimum 5 years in implementation of logic in based RTU systems like load shading, group control, control logic, reverse blocking, auto reclose etc. For submission of CV, 01 mark shall be awarded per CV subject to ceiling of 5 marks that can be obtained in this category.	5
4	Technical Know-How: The Bidder is expected to satisfy the following criteria for the proposed RTU based Automation Systems:	30
a)	Proposed product should be under life cycle growth (latest and having a life span under production for minimum next 10 years) as per Life Cycle of the product.	3
b)	RTU shall be capable to import multiple SCD files generated by multiple OEM	3
c)	RTU shall acts as SNTP Server & Client	3
	RTU shall support SNMP for Network & Asset Management	
d)	Configuration Tools should be complete in all respect like configuration of all types of interfaces and application as per RFP and complied to the format of SCD file for integration of multi vendors substation protection and control IEDs with RTU.	3
e)	Hardware and software of the proposed RTU shall be of the same OEM	3

f)	RTU integration with multiple OEM's protection, control, condition monitoring devices and SCADA on industry standard protocol	3
g)	RTU should support secured Web Server for remote monitoring, Upload and Download of the RTU configuration file from RTU to the engineering station.	3
h)	RTU should support GOOSING over IEC61850 (Ed.1 &2) Protocol	3
i)	RTU systems implemented for applications such as load shading, group control, control logic, reverse blocking, Auto change over, auto reclose etc.	3
j)	RTU shall be complied to Cyber Security requirement for critical infrastructure.	3

- 8.3.5 The bids will be evaluated technically on the compliance to specification terms and conditions as detailed in the various sections of the document.
- 8.3.6 Bidder must mandatorily quote against each item as per the functional requirement and of indicative bill of material.
- 8.3.7 Bidder must comply with Qualification requirement and compliance sheet.
- 8.3.8 Bidder must submit the list of sites and contact details in which similar solution have been developed and successfully running its operation. Purchaser team reserves the right to visit those sites and bidder shall facilitate such visit.
- 8.3.9 Bidders shall quote for all items specified including options and all the sub items in the specified format. Bids not complying with this requirement shall be liable for rejection. All bids and combination of bids shall be opened and evaluated simultaneously so as to determine the bid combination offering the most advantageous solution for the Purchaser.
- 8.3.10 The evaluation shall be made primarily on technical parameters and also the overall cost of the items and quantities mentioned in the schedule of quantities. However, while placing the order, or during the execution, the Purchaser reserves the right to modify the quantities of individual items.

9.0 Project Schedule / Calendar of Events / Milestones

- The Bidder shall provide a detailed Implementation Schedule indicating major Bidder and Purchaser activities, major completion milestone events, and interdependencies between events. Required Purchaser activities and associated dates must be clearly shown and include interdependencies to the Bidder's scheduled activities. The schedule shall be in terms of months after Receipt of Order (ARO), not absolute dates.
- The Bidder shall perform all scheduling activities with Microsoft Project/any standard software, such that all schedules as periodically transmitted to Purchaser include both hard copy and electronic versions.
- Following is the expected delivery schedule.

9.1 Delivery Schedule

9.1.1 Delivery schedule for the project SITC of RTU System

Sr. No.	Milestone	Target
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1	PO Placement	Zero Day
2	MDL & Project Detailed, Project Execution Schedule submission & approval	Within 10 days from Sr. No. 1
3	Architecture and other Drawings, Bill of Material finalization, Functional and Design Specifications (FDS), FAT & SAT documents submission & approval	Within 25 days from Sr. No. 1
4	Procurement of Hardware, Software and Manufacturing of Panel	Within 45 days from Sr. No. 3
5	Inspection of equipment (FAT)	Within 10 days from Sr. No. 4
6	Delivery of RTU Panel and Automation System	Within 10 days from Sr. No. 5
7	Completion of installation of RTU Panel and other system, cable laying, termination, RTU configuration as per substation data point etc.	Within 30 days from Sr. No. 6
8	Pre-SAT Testing	Within 30 days from Sr. No. 7
9	Final Integration Testing with SCADA	Within 30 days from Sr. No. 8
10	Resolving punch points and demonstration to Purchaser	Within 10 days from Sr. No. 9
11	Project closure after resolving of Punch points submission of documents and Software licenses	After 10 days from Sr. No. 10
12	Overall project schedule	200 days

9.2 Calendar of Events

Sr. No.	Events	Target
1	Detailed bid documents / hosting of detailed bid documents in Purchaser's ARIBA website	Zero Date
2	Pre-Bid Meeting with Bidders	Within 10 days from Sr. No. 1
3	Site visits by Bidder	Within 15 days from Sr. No. 1
3	Receipt of pre-bid queries, if any	Within 20 days from Sr. No. 1
4	Posting of Consolidated replies for the pre-bid queries to all bidders	Within 5 days from Sr. No. 3

Sr. No.	Events	Target
5	Receipt of Bids	Within 10 days from Sr. No. 4
6	Opening of technical bids	Next working day from Sr. No. 5
7	Date & Time of opening of Price of qualified bids	Will be notified to the successful bidders through our website / mail.

9.3 Milestones

Payment shall be made as per the finalized payment terms with Purchaser's procurement team as per the milestones mentioned below:

Sl. No.	Milestone Number	Milestone Description	Payment Plan (% of Contract Price)
1	MS-01	Prebid meeting	-
2	MS-02	Bid Submission	-
3	MS-03	Bid Discussion	-
4	MS-04	PO Placement	-
5	MS-05	Submission and Approval of following • Site Survey • List of Deliverables (BOM) • Configuration Drawings • Detailed Project Schedule • Functional Design Document • Design Documentation for Hardware & Software System • Application Overview Document • Any Other Documentation related to Design Engineering	10% of Total Contract Price
6	MS-06	System hardware staging completed in the Factory, Complete installation of all the Bidder standard baseline system (Hardware & Software) • Hardware Test Review & Signoff • Software Test Review & Signoff • Function Test Review & Signoff • Successful completion of FAT and resolution of all variances to Purchaser's satisfaction	15% of Total Contract Price on Pro-rata Basis

Sl. No.	Milestone Number	Milestone Description	Payment Plan (% of Contract Price)
7	MS-07	Delivery of the System (Hardware, Networks, Operating Systems, etc.) & acceptance by TP DISCOMS EIC	35% of Total Contract Price on Pro-rata Basis
8	MS-08	- Complete installation of the system at Purchaser's site, and successful completion of system startup activities. - Installation and commissioning of RTU based Automation System and its applications as per specification etc. - Installation and Commissioning of DC System - Integration of IEDs and Condition Monitoring System - Integration with Purchaser's SCADA Systems - Pre-SAT test acceptance	15% of Total Contract Price on Pro-rata Basis
9	MS-9	Successful completion of SAT and resolution of all variances to Purchaser's satisfaction after completion of all test plans and procedures. This includes: - Site Preparation Plan - Witness demonstrations of all custom features - Field Update Period completed - Rectification of Bugs/ Issues if any reported after Pre-SAT - Training on O & M of System - Availability of Complete functionality as specified in the specification and scope of Work - Demonstration of Performance Guarantee Parameters - Cyber Security Test - System Handover for Operation	15% of Total Contract Price on Pro-rata Basis
10	MS-10	Operational Acceptance and submission As-built drawings, spares: - Successful completion of System Availability and Performance Guarantee tests - Submission of Operator's User's Manual, Modification if any to the Operator's User's manual and submission of approved manual - Submission of Backup of entire system on secondary media	10% of Total Contract Price on Pro-rata Basis

Sl. No.	Milestone Number	Milestone Description	Payment Plan (% of Contract Price)
		Delivery of all As-built drawings, database and logic files, source code and final documents Delivery of spares, maintenance & testing equipment's etc.	

All invoices to be cleared within 30 days of invoice date; certified by TP DISCOMs EIC

10.0 Submissions by Bidders

10.1 Mandatory Documents required along with the Bid

Bidders are requested to submit their offer in line with this bid document. Purchaser shall respond to the clarification raised by various bidders and the replies will be sent to all participating bidders through ARIBA.

Bidder shall submit the document as specified in **Section-D** and as described in various section of this document.

The technical bid shall be properly indexed and is to be submitted in Soft Copy and three nos. Hard Copy.

CPRI report for the product offered as per the GoI order no. 25-17/6/2018-PG dated 2nd July 2020 and subsequent order No. 12/34/2020-T&R dated 8th June 2021

10.2 Departure from Specifications

Bidder shall necessarily submit a signed and stamped copy of this BID (in original) as a token of acceptance of all the terms and conditions of this BID. Replication of this BID on bidders' document shall not be acceptable. Normally no deviation is accepted to BID document supplied with the bid & bid with deviation is liable to be rejected. However, in case of any deviations to this BID, all such deviations shall be furnished by the bidders in the Schedule of Deviations attached as Section-C, Item-C3, and submit the same as a part of the Technical Bid.

10.3 Right of Acceptance / Rejection of Technical Proposal

Bids would be rejected in absence of following documents:

- Details required for PQR not submitted
- Complete technical details are not enclosed
- Proposed Architecture not submitted
- The offer does not contain un-priced detailed Bill of Material as per the proposed architecture
- Bid is received after due date and time
- False Information / Details

Purchaser reserves the right to accept/reject any or all the bids without assigning any reason thereof.

10.4 Documentation & Licenses

Bidder shall submit the documents as per **Section D** for bid submission and Post Award. Bidder to ensure that all software procured shall be perpetual license in the name of the Purchaser.

11.0 Project Management

11.1 Project Implementation

This section specifies project implementation requirements, including Purchaser and the Bidder responsibilities, project management procedures, project documents, the activities leading up to shipment of the RTU and Communication systems, and the installation, commissioning, and site test activities.

11.2 Project Management

The Bidder and Purchaser shall assign a project manager with the authority to make commitments and decisions that are binding on the either side with the following responsibilities:

11.2.1 Purchaser's Project Manager

Purchaser's project manager shall be responsible for representing Purchaser's interests throughout the project. Purchaser's project manager will, from time to time, authorize other staff to act in this regard for specific tasks. The project manager will also change such assignments from time to time. Such actions shall be submitted to the Bidder in writing.

All correspondence with Purchaser shall be addressed to Purchaser's project manager.

11.2.2 The Bidder's Project Manager and Project Personnel

The Bidder shall designate a project manager who shall be responsible for the co-ordination of all project work and for the communications between the Bidder and Purchaser. Except for conditions outside the control of the Bidder, the Bidder's project manager shall not be removed or replaced without the approval of Purchaser.

Bidder shall submit the manpower deployment plan along with the bids, describing the key roles of each person. The project shall be staffed with a core project team. Additional personnel shall be assigned to work under the direction of the core team. Core project team members shall have experience as stated elsewhere in this document.

The Bidder shall inform Purchaser of any pending or possible changes in the use or status of all Bidder project personnel. Any changes to Bidder staff, including work assignments and participation level, shall be announced as soon as practical and shall be subject to Purchaser's approval. Purchaser shall have the right to have any Bidder staff removed from the project for cause.

11.3 Project Management Practices

Bidder shall provide high-level details of the project management practices that will be followed to manage the project. The project management practices would include (but not be limited to) details of:

- a. Bidder must provide details of how they envisage the contract being managed and control mechanisms; regular and active review meetings; Project management of individual work streams and overall program management of the entire service; Performance reporting

- b. Bidder should outline their proposed governance structure and designate a Service Manager to co-ordinate their activities and provide a focal point of contact to which Purchaser can refer on any matter concerning the service.
- c. Reporting lines and decision-making powers within the bidder's organization must be submitted
- d. Reporting formats and templates that would be followed by the bidders
- e. Outline the proposed escalation procedures if issues arise.

11.4 **Project Schedule**

The project should be implemented as per the prescribed schedule. Based upon this schedule the bidder shall submit a preliminary implementation plan along with the bid. The detail project implementation schedule shall be submitted by the bidder after award for Purchaser's approval, which shall include at least the following activities:

- a. Site Survey
- b. Documents submission and approval schedule
- c. Factory & Site Testing Schedule
- d. RTU Database development schedule
- e. Hardware purchase & Manufacturing, Software development & integration schedule
- f. Dispatch Schedule
- g. Installation / commissioning schedule
- h. Training schedule

11.5 **Progress report**

A progress report shall be prepared by the Bidder each month against the activities listed in the project schedule. The report shall be made available to Purchaser on a monthly basis, e.g., the 10th of each month. The progress report shall include all the completed, ongoing and scheduled activities.

11.6 **Transmittals**

Every document, mail, letter, progress report, change order, and any other written transmissions exchanged between the Bidder and Purchaser shall be assigned a unique transmittal number. The Bidder shall maintain a correspondence index and assign transmittal numbers consecutively for all Bidder documents. Purchaser will maintain a similar correspondence numbering scheme identifying documents and correspondence that Purchaser initiates.

11.7 **Implementation Responsibilities**

The general responsibilities of Purchaser and the Bidder are presented below. Other sections in the Specification may also present responsibilities. If the requirements of any other sections conflict with the responsibilities of this section, the responsibilities of the other sections shall take precedence over this section.

11.7.1 **Bidder's Responsibilities**

The Bidder's specific responsibilities shall include:

- a. Providing all RTU and Communication systems equipment and related support materials, including all interconnecting cables and wiring between all Bidder-provided equipment and between the RTU and any equipment furnished by Purchaser
- b. Defining the stock of spare parts needed to maintain for system availability
- c. Providing all engineering, software design, development, and integration services necessary for RTU and Communication Systems implementation
- d. Ensuring that all reasonable security measures have been incorporated in the RTU and Communication Systems upon delivery, is free of viruses, trapdoors, and other software contaminants, contains no software enabled with “electronic self-help”, is purged of all sample scripts and sample code, and has had all default accounts and passwords removed or disabled.
- e. Managing, coordinating, and scheduling the activities of all Sub-vendors employed by the Bidder for this project. This shall include the resolution of all problems that may arise in connection with the hardware, software, and services supplied by the Sub-vendors.
- f. Implementing the RTU and Communication Systems according to the quality standards acceptable to Purchaser.
- g. Training Purchaser staff so that they will be self-sufficient and able to operate, maintain, and upgrade the complete RTU and Communication Systems.
- h. Supplying RTU and Communication Systems documentation such as instruction manuals, maintenance manuals, drawings, software design and user documentation, and other appropriate material that together fully defines the supplied system and allows Purchaser to operate, maintain, backup, restore, and upgrade the RTU and Communication Systems hardware and software
- i. Supplying final (“as built”) documentation that is accurate and complete.
- j. Providing adequate facilities and resources for, as well as performing, factory testing
- k. Providing an environment that allows for reproducible execution of all RTU and Communication Systems functional performance tests conducted during factory acceptance testing
- l. Transportation, delivery and temporary storage of all Bidder-provided equipment and materials to Purchaser's site or sites
- m. Performing the installation of the RTU and Communication Systems at Purchaser’s site under Purchaser’s supervision
- n. Performing, with Purchaser’s assistance, system start-up after satisfactory system installation, i.e. powering up the system, loading correct versions of all software and databases, activating data links, verifying correct operation of the system, and turning over to Purchaser an operational system ready for site testing
- o. Performing after delivery and start-up of the system, but prior to any site testing, setting up all functions for proper operation (system and function “tuning”)
- p. Performing the test at Purchaser’s site, including correcting all reported variances
- q. Ensuring and periodically demonstrating that the work is progressing according to the approved schedule
- r. Maintaining the RTU and Communication Systems up to the start of the warranty
- s. Providing and implementing all required warranty services

11.7.2 Purchaser’s Responsibilities

Purchaser will be responsible for the following:

- a. Providing input raw AC power to equipment enclosures
- b. Reviewing and approving project deliverables such as, but not limited to, detailed implementation schedule, software and hardware functional design documents, user manuals, drawings, progress reports, training program, quality assurance plan, test plans and procedures, test results, support services (including maintenance), and as-built system documents
- c. Coordinating and supervising the Bidder's work to be performed at Purchaser facilities
- d. Attending pre-factory tests (at Purchaser's discretion)
- e. Participating in factory tests and approving test results
- f. Assist the Bidder with the installation
- g. Monitoring the site tests and approving test results
- h. Monitoring the availability test and approving test results
- i. Preparing variance reports, resolving variance issues, and approving corrected variances
- j. Determining if the Bidder's work is progressing in accordance with the schedule
- k. Verification of all Bidder materials, installation practices, and workmanship conform to requirements
- l. Providing facilities for on-site training and Bidder offices.

12.0 Quality Requirements, Inspection, Installation, Commissioning and Testing

12.1 Quality Assurance

Quality of service - Bidder must provide details of their proposed approach to quality assurance to ensure the quality of services in accordance with RFP Document. This should include:

- a. Responsibility of quality of service.
- b. How the bidder will ensure quality service is provided.
- c. How quality will be measured
- d. Bidder shall submit their quality certification / Assessment document. Bidder shall provide the following information along with the documents.

Description	Bidder's Response
Certification / Assessment Name	
Who issued the Certification / Assessment?	
When was the Certification / Assessment obtained?	
Does this Certification / Assessment process involve periodic reviews and observations / remarks after such review? If so, please provide details and specify when your company is due for its next quality review?	

Table: Details of Certification

All materials and parts of the Bidder's own and Sub-Vendors System / Sub-System to be supplied under this project shall be current, in line with industry standard.

12.1.1 Quality Assurance and Testing

To ensure that the Bidder produces a well-engineered and contractually compliant RTU and Communication Systems, a quality assurance program shall be followed and both structured and unstructured tests shall be performed.

12.1.2 **Quality Assurance Program**

The Bidder must employ documented Quality Assurance (QA) techniques and practices throughout this project. This QA program shall be adhered to for the preparation of all Contract deliverables, including documentation, hardware, firmware and software. The program shall provide for the minimization of defects, the early detection of actual or potential deficiencies, timely and effective corrective action, and a method to track all such deficiencies.

12.2 **Inspection**

Purchaser shall be allowed access to the Bidder's facilities during system design, manufacturing and testing and to any facility where hardware or software is being produced. The Bidder shall provide office facilities, equipment, and documentation necessary to complete all inspections and to verify that the RTU and Communication Systems is being fabricated and maintained in accordance with the Specification to Purchaser's representatives.

Purchaser shall be allowed to review and verify the functional implementation of RTU and Communication Systems software informally in conjunction with scheduled project meetings at the Bidder's facilities. No test plans, procedures, or reports are required to support these informal software demonstrations.

Purchaser shall be allowed to inspect the Bidder's hardware and software quality assurance standards, procedures, and records. Documents identified in the approved product quality assurance plan will be inspected to verify that the Bidder has performed the required quality assurance activities.

The inspection rights described above shall not apply to sub-bidders supplying standard computer or peripheral equipment and third-party software products. However, inspection rights shall apply to Sub-Vendors that are developing new software, offering solutions for inclusion in the RTU and Communication Systems.

12.3 **Commissioning**

12.3.1 **Receipt at site, Handling, Storage & Insurance**

1. Bidder shall make his own necessary arrangements for storage space for the proposed system and shift the material at site as per the execution plan or the purchaser can provide the space in the substation to keep the material. However, loss of material or any damage shall be the liability of the bidder.
2. Bidder will be responsible for unpacking of the material supplied during the site execution, in the presence of TP DISCOMs EIC/Site in charge. In case of any material discrepancy will be the liability of the bidder.

Delivery and movement of material to site from stores shall be the responsibility of Bidder.

12.3.2 **Installation**

Installation of the complete system is under Bidder's scope. Installation work shall be scheduled and carried out in coordination with Purchaser's representatives. All related drawings, installation manuals and recommended practices shall be submitted in advance for Purchaser's approval. Installation shall be certified by the Principal's representative.

12.3.3 **Cabling Scope (Supply, Laying, Installation and Termination)**

The following shall be in the bidder's scope

- a. All cables to and from any equipment supplied by Bidder
- b. All cables shall be tagged appropriately, cross ferruling shall be used for identification of the Cable, Inter/Intra Panel wiring.
- c. All cables between Purchaser's Power Supply Distribution Board to any equipment supplied by the Bidder.
- d. Earthing interface to earth pit based on the earthing scheme provided by the Bidder (It shall be completely Bidder's responsibility to ensure proper earthing).
- e. The above includes all electrical and communication cables (if any) and all associated terminals, Connectors, tools, distribution board, MCBs and Automation accessories.
- f. Appropriate civil work for housing the control cable, communication cables in the switch yard / control room.

12.3.4 **Commissioning Activities**

- a. The commissioning of the system (hardware and software) including SAT and one Month Trouble free operation shall be the responsibility of Bidder.
- b. Adequate number of qualified engineers (Hardware & Software) as approved by Purchaser shall be posted at site during the entire period of installation & commissioning for RTU based substation automation.
- c. Daily site work shall be planned and executed as per due approvals from Purchaser's representative.
- d. Bidder shall submit detailed site organization chart of Personnel for Purchaser's approval. Purchaser reserve the right to review the same. Bidder's commissioning engineers shall also train purchaser's engineers during commissioning apart from scheduled Training.
- e. The responsibility for Installation, Commissioning, Performance guarantee and warranty shall remain with the Bidder.
- f. The Bidder shall furnish procedures, protocols for commissioning and acceptance test activities.
- g. All tools (both hardware and software), test instruments, simulation jigs, documents, programming equipment etc. required for Installation, Testing & Commissioning are in the scope of bidder.
- h. All passwords, access keys etc. are the property of the Purchaser and shall be handed over to the Purchaser.
- i. All interoperability tables for interfacing to Automation systems shall be supplied.
- j. Principal's qualified representatives including specialists shall participate at site for supervision, & certification of commissioning and Acceptance tests.

The Bidder shall comply and adhere to the safety policy of the Purchaser. Hence necessary safety apparels shall be borne and used by Bidder for their personnel at their cost. Also, it is the responsibility of the Bidder to ensure their compliance to statutory requirements of their workmen. All the workmen engaged at the TP DISCOMs site should have necessary ESIC and PF registration.



12.4 Testing

12.4.1 Test Responsibilities

Both Purchaser and the Bidder shall designate, in writing and prior to the start of the factory test, a test coordinator. Each coordinator shall be responsible for ensuring that the tests are conducted in accordance with the requirements of this Contract. The coordinators shall each have the authority to make binding commitments for their Purchaser such as approvals of test results and scheduling for variance corrections or, as a minimum, to cause such commitments to be expeditiously made.

Unless otherwise stated in this Specification, the Bidder shall be responsible for all factory tests. This responsibility shall include the conduct of the tests and all record keeping and document production. Bidder will support the factory testing by supplying staff to execute the test procedures under the Purchaser's supervision.

12.4.2 Test Documents

Test plans, procedures, and records shall be provided by the Bidder for all tests to ensure that each test is comprehensive and verifies the proper performance of the RTU and Communication Systems elements under test. During the development of test plans and test procedures, emphasis shall be placed on testing each conditional logic statement, checking error conditions, and documenting the simulation techniques used. The test plans and test procedures shall be modular to allow individual test segments to be repeated as necessary.

All test plans and test procedures (standard, modified standard, and custom functions) shall be submitted to Purchaser for approval and shall be subject to the approval process as defined in **Section-D, Item 2.5 Document Review and Approval**.

12.4.3 Test Plans

The test plans shall describe the overall test process, including the responsibilities of individuals and the documentation of the test results. The following shall be included in the test plans:

- a. The schedule for the test
- b. The responsibilities of Bidder and Purchaser personnel, including record-keeping assignments
- c. Any forms to be completed as part of the tests and the instructions for completing the forms
- d. Procedures for monitoring, correcting, and testing variances
- e. Procedures for controlling and documenting all changes made to the hardware and software after the start of testing
- f. Block diagrams of the hardware test configuration, including the Bidder- and Purchaser-supplied RTUs, external communication channels, and any test or simulation hardware.

Test plans shall be provided for the Factory Acceptance Test, Site Acceptance Test, and Availability Test.

12.4.4 Test Procedures

The test procedures shall describe the methods and processes to be followed in testing the RTU and Communication Systems. The test procedures shall be modularized, such that individual functions of the RTU and Communication Systems can be independently tested and so that the testing proceeds in a logical

manner. This section uses the term segment to refer to a higher-level part of a test procedure and the term step to refer to the most detailed level of test instruction.

The test procedures shall include the following items:

- a. The name of the function to be tested
- b. References to the functional, design, user, and any other documents describing the function
- c. A list of test segments to be performed and a description of the purpose of each test segment
- d. The set-up and conditions for each segment, including descriptions of the test equipment and data to be supplied by the Bidder and by Purchaser.
- e. Descriptions of the techniques and scenarios to be used to simulate system field inputs and controlled equipment
- f. Descriptions, listings, and instructions for all test software tools and displays
- g. Step-by-step descriptions of each test segment, including the inputs and user actions for each test step
- h. Forms for the recording of test results
- i. The expected results for each segment, including pass/fail criteria
- j. Copies of any certified test data to be used in lieu of testing, if approved by TP DISCOMs.

The Bidder shall note that Purchaser will not accept any certified test data in lieu of testing except where specifically stated in the Contract.

12.4.5 Test Records

Complete records of all tests result shall be maintained. The records shall be keyed to the test procedures. The following items shall be included in the test records:

- a. Reference to the appropriate test procedure
- b. Date of the test
- c. Description of any test conditions, input date, or user actions differing from that described in the test procedure
- d. Test results for each test segment including a passed/failed indication. All information recorded during the test such as measurements, calculations, or times shall be included in the results.
- e. Identification of the Bidder's and Purchaser's representatives performing and witnessing the test
- f. Provision for comments by Purchaser's representatives
- g. References to all variance reports generated
- h. Copies of reports, display copies, and any other hardcopy generated as part of the test.

12.4.6 Variance Recording and Resolution

A variance tracking system shall be placed in service no later than one month before the start of Pre-FAT and shall remain in use through the completion of the warranty. Both the Bidder and Purchaser may initiate variances at any time. Variances may be used to record system deficiencies at any time, even if the system is not undergoing testing. This variance tracking system shall record and track variances for:

- a. Documentation deficiencies
- b. Functional deficiencies
- c. Performance deficiencies

- d. Procedural deficiencies (as when deviations from contractually required QA procedures are observed)
- e. Test deficiencies (as when the system cannot satisfactorily complete a test procedure due to a problem with the test).

The variance recording and tracking system shall produce reports of all variance information and shall produce subsets of the variances based on searches of the variance parameters singly and in combination. Variance reports shall always be available to Purchaser. The Bidder shall periodically distribute a variance summary that lists for each variance the report number, a brief overview of the variance, its category, and its priority.

12.4.7 Variance Records

The record of each variance shall include the following information:

- a. The date of the initial discovery of the variance
- b. A variance number – a sequential number assigned when the variance is entered into the tracking system
- c. An identification of the person submitting the variance and the names of any other witnesses or knowledgeable Purchaser or Bidder staff
- d. An identification of the RTU and Communication Systems component, such as a hardware item or software function, against which the variance is being written
- e. An identification of the test plan or procedure, if applicable. The stage or step of the plan or procedure shall be identified
- f. An overview of the variance suitable for use in keyword searches
- g. A detailed description of the variance
- h. A variance category:
 - i. Open (recorded but not scheduled for further action)
 - ii. Assigned (scheduled for further action)
 - iii. Pending (the variance has been resolved but not tested)
 - iv. Closed (Purchaser has accepted the resolution)
- i. The date of assignment into each category
- j. A variance priority:

Critical	To be used only if the RTU and Communication Systems is in commercial use, this priority identifies a problem that prevents the use of a system features that is essential to Purchaser's operation of the power system
High	Denotes the failure of the RTU and Communication Systems to perform a required feature in a manner that significantly reduces the utility of the systems or feature or which delays further testing of the systems or features
Normal	Denotes the failure of the RTU and Communication Systems to perform a required feature in a manner that reduces the utility of the systems or features. Normal priority variances shall not delay any testing
Low	Denotes the failure of the RTU and Communication Systems to perform a required feature in a manner that reduces the utility of the systems only slightly. Low priority variances shall not delay any testing. Variances that record transient failures, which cannot be readily reproduced, shall

be initially assigned to this priority. Subsequent occurrences of the transient failure shall result in raising the priority of the variance.

A description of the resolution, including identification of all hardware, software, and documents modified or otherwise changed and the names of the Bidder or Purchaser staff involved with the resolution

- k. A record of all testing performed
- l. Identification of Purchaser staff accepting the resolution and the date of acceptance.

12.4.8 **Schedule for Variance Correction**

The Bidder and Purchaser shall meet periodically to review the variance list. Each new variance opened since the previous meeting shall be scheduled for correction at the meeting. Purchaser and Bidder shall follow these guidelines for scheduling corrections:

- a. A schedule for the correction of critical and high priority variances shall be set within one working day of their discovery. The schedule for correction of all other variances shall be set within one working week of their addition.
- b. Purchaser and the Bidder shall assign resources for the correction of critical variances with the intent of correcting the variance within two working days of their opening.
- c. Purchaser and the Bidder shall establish a mutually agreeable date for the correction of high priority variances, with the overall objective of:
 - i. If the RTU and Communication Systems is in productive use, correcting the variances within one calendar week of their discovery
 - ii. Prior to the commencement of productive use, maintaining the overall project schedule
- d. Purchaser and the Bidder shall establish a mutually agreeable date for the correction of normal priority variances, with the overall objective of:
 - i. If the RTU and Communication Systems is in productive use, correcting the variances within one calendar month of their discovery
 - ii. Prior to the commencement of productive use, maintaining the overall project schedule
- e. Low priority variances may be scheduled for correction at any time and shall not exceed 30 days after identification.

12.4.9 **Variance Resolution**

A variance shall be deemed resolved only upon written acceptance of the correction by Purchaser. Prior to submitting the corrected variance for acceptance by Purchaser, the Bidder shall take all reasonable steps to verify that the correction has resolved the variance and the Bidder shall update the variance record to reflect the corrective action taken. Purchaser shall then schedule any testing to be performed in conjunction with the Bidder.

A variance shall be deemed accepted and the variance record shall be completed only after Purchaser has tested the corrected variance to its satisfaction. The Bidder shall support all testing deemed necessary by Purchaser to verify the corrections.

12.4.10 **Test Schedule**

The sequence of tests to be performed and their scheduling with respect to other activities shall be mutually decided.

12.4.11 Test Initiation

The following conditions must be satisfied before starting any test:

- a. Purchaser has approved all plans and procedures for the test
- b. Purchaser has reviewed or approved all relevant documentation
- c. A copy of all relevant documentation including design and maintenance documents, user manuals, test plans, and test procedures has been placed on the test floor
- d. A complete regeneration of the software under test has been performed immediately prior to the start of testing
- e. All operating system parameters, files, and configuration information has been saved to archive media so that the RTU and Communication Systems operating environment can be recreated.
- f. All database, display, and report definitions have been saved to archive media so that the System databases, displays, and reports can be recreated if necessary.
- g. All source code libraries have been saved to archive media so that RTU and Communication Systems software can be regenerated if necessary.
- h. For the factory test, preliminary testing, as described in **Item-12.4.15 Preliminary Factory Testing** has been completed and the Bidder has submitted written certification that the preliminary testing has been successfully completed.

For the availability test, all critical, high, and normal variances have been corrected and verified to the satisfaction of Purchaser

12.4.12 Test Completion

A test shall be deemed to be successfully completed only when:

- a. All variances have been resolved to the satisfaction of Purchaser
- b. All test records have been transmitted to Purchaser
- c. Purchaser acknowledges, in writing, successful completion of the test.

12.4.13 Test Suspension

If Purchaser believes, at any time, that the quantity or severity of RTU and Communication Systems variances warrants suspension of any or all testing, the test shall be halted, remedial work shall be performed, and the test shall be repeated. The repeat of the test shall be scheduled for a date and time agreed upon by both the Bidder and Purchaser.

12.4.14 Modifications to the RTU and Communication Systems during Testing

No changes shall be made to the RTU after factory testing has started without the express authorization of Purchaser. It will be Purchaser's intent to carefully control the test environment so that all changes can be readily identified and so that any changes installed for any purpose can be removed and the previous test environment restored. Purchaser shall have the right to suspend testing, to revert to a previous version of any software or hardware, and to restart any testing previously performed if, in its opinion, changes have been made to the system under test without authorization.

12.4.15 Preliminary Factory Testing

The Pre-FAT shall be a complete dry run of the FAT, following the test plans and procedures. The intent is for the Bidder to detect and correct most design, integration, database, display, and performance problems prior to the FAT. The Bidder's project manager shall sign off each test. The completed test results shall be sent to Purchaser for inspection before Purchaser's personnel travel to the Bidder's facilities for the FAT. All tests shall be conducted using Purchaser-specific databases unless Purchaser authorizes the Bidder to use a test database.

The Bidder shall notify Purchaser at least fifteen days prior to the start of the Pre-FAT, and Purchaser shall have the option to witness all or parts of it. The Bidder shall notify Purchaser when the Pre-FAT has been successfully completed and the RTU and Communication Systems is ready for FAT.

12.4.16 Factory Acceptance Test (FAT)

Factory tests shall include:

- a. Equipment test
- b. Functional test
- c. Performance test
- d. Stability test
- e. Unstructured test
- a. **Equipment Test**

The equipment test shall verify that the RTU and Communication Systems includes all required equipment, that the equipment is properly configured, and that the equipment can successfully execute the diagnostic programs provided.

The equipment tests shall include a visual inspection for proper workmanship, including cables, connectors, and labeling. The assembly drawings and configuration drawings shall also be verified at this time. These tests shall also verify that the required RTU and Communication Systems capacity performance and expansion requirements as specified in this specification have been satisfied.

b. Functional Test

The functional test shall use an equipment configuration that may include an extension of the Bidder's deliverables as required to prove the correct functionality of the RTU and Communication Systems. The test procedures shall consider all additional test equipment and shall ensure that the additional equipment does not create false test results. The functional tests shall rigorously exercise all functions and devices, both individually and collectively, and shall verify the correct functional operation of all hardware and software. These tests shall include the following, as may be applicable to the system under test:

- a. Verification of all required functionality of the system, such as RTU and Communication Systems, applications, data exchange, and information storage and retrieval. Verification shall include all standard and custom functions as well as purchased options.
- b. Verification that all software has been correctly sized and meets Purchaser's capacity requirements
- c. Verification of proper acquisition, processing, and storage of data from appropriate sources, and verification of protocol and data exchanges with all external systems that will interface with the system.

Where necessary, the Bidder shall provide appropriate simulations of the external systems; such simulations must themselves be verified before being used.

- d. Verification of all user interface functions
- e. Verification of the application program and system development capabilities including, software configuration management, source code development, documentation management, user interface development, real-time data set development, database generation and maintenance, report generation and modification, alarm and event message definition, test environments, and other utility functions
- f. Verification of communications maintenance capabilities including diagnostics, communications maintenance (RTU, data links, interfaces etc.), and local input/output maintenance.
- g. Verification of all hardware maintenance capabilities.
- h. Verification of the proper response of the system to at least the following abnormal situations:
 - i. Loss and restoration of processors and servers, including auxiliary memory
 - ii. Loss and restoration of user interface equipment
 - iii. Loss and restoration of archive storage devices
 - iv. Loss and restoration of external subsystems
 - v. Loss and restoration of input power
 - vi. Loss and restoration of communication network processors
 - vii. Loss and restoration of any other peripheral devices
 - viii. Loss and restoration of local and wide area network elements
 - ix. Detection of and recovery from communication errors
- i. Demonstration of the security of the system from unauthorized access
- j. Verification of the redundancy and failure recovery schemes of the system
- k. Verification that changes of system time will not prevent the system from operating properly and that the system can correctly handle the beginning of a new day, month and year, leap years and the change in century and decade.
- l. Documentation verification that will verify that all documentation to be delivered with the system is present and meets requirements.

c. Performance Test

The performance test shall verify that the specified performance requirements are met. Simulation shall be provided by the Bidder, where necessary, to create the conditions for the specified performance scenarios. The simulations shall be tested first to verify that the desired activity is being simulated. Execution of the performance tests shall be automated as much as possible so that test runs can be reproduced.

d. Stability Test

A 100-hour continuous run of the system shall be performed after successful completion of the functional and performance tests. The stability test will be considered successful if no critical function is lost, no major hardware failure occurs, no failover occurs, and no restarts occur within the test period.

Major hardware failure is defined for the purpose of this test as the loss of hardware such as a processor, Power Supply, Communication port, I/O cards etc.

During this test, the system shall be exercised (with simulated inputs, events, and conditions) in a manner that approximates an operational environment. Purchaser will simulate unstructured user activity during this test. Purchaser will not purposely cause any hardware or software failure, that is, failover and restart testing is not a goal of this test.

The Bidder shall assist Purchaser in this test as required by Purchaser; this assistance will be primarily in the form of helping the set-up of the test, explaining the best procedures to run the test, and explaining all unexpected results.

e. Unstructured Test

The test schedule shall allow time throughout the functional testing for unstructured testing by Purchaser. Time for unstructured testing shall be reserved at the rate of at least two hours of unstructured testing for each eight hours of structured testing, but no less than two days total. This time will be used by Purchaser to perform additional tests, the need for which may be recovered during the formal testing, and to investigate any potential problems detected. The unstructured tests will be performed during the functional and performance test period and during the stability test at the discretion of Purchaser.

The Bidder shall assist Purchaser in this test as required by Purchaser; this assistance will be primarily in the form of helping the set-up of the test, explaining the best procedures to run the test, and explaining all unexpected results.

12.4.17 Site Acceptance Test (SAT)

The site test includes the installation test, the functional test, and the performance test as specified in the factory test that will be conducted at Purchaser's site after shipment and installation of the RTU and Communication Systems.

SAT shall cover all equipment and functions as specified for the complete system (all hardware & software) and connectivity with Purchaser's system. As such SAT shall cover all the tests listed in FAT along with site-specific tests including interconnections with field equipment and other systems. Apart from testing and commissioning, SAT shall include one month of continuous trouble-free operation of the complete system without major intervention. In case of interruptions, one month trial shall be restarted after attending to the problem.

- i. IEDs used for protection, control, etc.; the inter-bay bus (and associated communications hardware/software), the station bus (and associated communications hardware/software), the time synchronization system and the local/station HMI (if any) are to be considered as SAS components, and shall undergo commissioning requirements as part of the SAT.
- ii. Vendor shall furnish, advance SAT protocols and list of vendor's instruments for site testing. Tests shall include demonstration of loading & expandability of the system.
- iii. SAT shall be performed after the system has been installed, the final software has been loaded in each subsystem, all I/Os and functionality checked, system has been running and all commissioning checks have been completed successfully.
- iv. Unstructured tests shall be employed as necessary, to verify overall system operation under field conditions.

12.4.18 Installation Test

The installation tests shall be conducted by the Bidder and include:

- A repetition of the equipment test
- Loading of configuration of the RTU and Communication Systems software and starting the system. At the option of Purchaser, configuration shall be recompiled, if required.
- In cooperation with Purchaser, establishment of the communication with all data sources and other systems that interface with the Systems
- Initialization and preliminary tuning of application software as needed.

12.4.19 Functional and Performance Tests

The site functional and performance tests shall be comprised of a subset of the functional and performance tests of **Section 14**, The tests to be performed shall be proposed by the Bidder and approved by Purchaser. These tests shall be extended as necessary to test functions simulated during the FAT, such as communications with all field devices and all other systems that interface with the RTU and Communication Systems. The extended tests shall be performed to a test procedure prepared by the Bidder and approved by Purchaser. Unstructured tests shall also be employed, as necessary, to verify overall operation of the systems under actual field conditions.

12.4.20 Availability Test

RTU and Communication Systems and device availability in accordance with the criteria specified in the specification, System Availability shall be demonstrated by the availability test.

Predicted availability of equipment supplied shall exceed the following:

System Function	System Availability
Control and Monitoring of any one equipment (Breaker, Isolator etc.)	99.99%
Monitoring of Any One Single Alarm	99.99%
Monitoring of Any One Analog Input	99.99%

12.4.21 Test Activity

The test activity shall consist of normal RTU and Communication Systems in use. Purchaser will modify the configuration during the availability test. Such modifications will be described to the Bidder at least 48 hours in advance of implementation to allow assessment of impact on the availability test, except where such changes are necessary to maintain control of the power system.

12.4.22 Test Definitions

The definitions of the time periods used in determining the duration of the test and the success of the test shall be as follows:

- Downtime** – Downtime occurs whenever the criteria for successful operation defined in specification, Availability Requirements – RTU and Communication Systems, are not satisfied. Downtime shall be measured from the start of diagnostic procedures until full service is restored. In the event of multiple failures, the total elapsed time for repair of all problems (regardless of the number of maintenance personnel available) shall be counted as downtime.
- Hold time** – Certain periods of time during which the RTU and Communication Systems is down may be due to circumstances that are beyond the control of either party. These contingencies may prevent successful operation of the systems but are not valid for the purpose of measuring systems availability. Such periods of unsuccessful operation may be declared hold time by mutual agreement of Purchaser and the Bidder. Specific instances of hold time are:
- Scheduled shutdown** – During scheduled shutdowns or if an equipment failure occurs due to scheduled maintenance, the resulting system outage shall be hold time, provided that service can be restored according to the Bidder-specified procedures within 30 minutes.
- Power Interruption & environmental excursion** – Loss of power or manual shutdown of the RTU and Communication Systems in the event of power excursion or the loss of environmental control shall be considered hold time. If the systems are operated during periods of power or environmental conditions beyond those specified, any resultant downtime shall be considered hold time.
- Intermittent failure** – Periods during which an intermittent, recurring failure is experienced will be considered hold time, provided that the Bidder is engaged in remedial action and normal operation of the RTU and Communication Systems can be restored within 30 minutes by Bidder-defined procedures whenever the failure occurs. Instead of accounting for the actual intermittent downtime, one hour of downtime shall be counted for each 120 hours of otherwise successful operation while the problem persists.
- Failure of Purchaser software** –Time during which the RTU and Communication Systems software is upgraded shall be considered hold time. Of course, Systems can be restored within 30 minutes by Bidder-defined procedures.
- Corrected design defect** – Hold time may be declared by mutual agreement to ensure against similar future occurrences if a failure occurs due to a defect in design for which the Bidder defines and implements corrective measures. In such a case, enough hold time shall be allocated to allow verification of the corrective action.

- Logistics delays** – If repairs are delayed due to previous use of spare parts or because of Purchaser’s failure to purchase recommended spare parts, hold time will be declared after diagnosis of the failure and while the Bidder is pursuing replacement parts in an expeditious fashion. A maximum of 48 hours of hold time will allowed for each occurrence of logistics delay.
- Service response time** – Hold time shall be declared from the time that a failure is detected until diagnostic procedures are begun. A maximum 24 hours of hold time will be allowed for each failure.
- Total time** – The time elapsed from the start of the availability test until the end of the availability test
- Test time** – The time elapsed from the start of the availability test until the end of the availability test, excluding hold time. That is,

$$\text{Test_time} = \text{Total Time} - \text{Hold_time}$$

12.4.23 Duration and Criteria for Passing

In order to establish that all failures have been satisfactorily repaired prior to the end of the availability test, no downtime, intermittent (hold time) failures, or more than one uncommanded failover shall have occurred within 200 hours of the test's conclusion. The test shall be extended, if necessary, to satisfy this requirement.

After successful completion of site acceptance test and 72 hours have passed, system availability shall be computed using the following formula:

$$\text{System_Availability} = [(\text{Test_time} - \text{Down Time}) / \text{Test_time}] \times 100\%$$

If the system availability requirements presented in the specification, System Availability, have not been met, the test shall continue until the specified availability is achieved. Alternatively, and at Purchaser’s discretion, the test may be restarted.

When it has been determined that the system availability requirement has been met, the availability of each System device shall be calculated and compared against the device availability requirements as specified, Availability Requirements – RTU and Communication Systems. If one or more devices do not meet the requirements, the test shall be extended until Purchaser and the Bidder mutually agree that corrective action has been completed for those devices. Corrective action shall include all necessary procedures to test and verify proper operation to Purchaser’s satisfaction.

13.0 System Capacity, Performance and Demonstration

Proposed System shall meet performance standards required to maintain real-time monitoring and control of the network. Performance shall be evaluated according to the amount of time and controller resources required for accomplishing a variety of tasks. The tasks are grouped into the following major function areas:

- a. Data Acquisition and processing

- b. Data Archive processing
- c. Data transfer to Control Centre
- d. Response to the request of SCADA/DMS & OMS System

13.1 System Capacity

The system functions and associated databases shall be capable of accommodating at least a 100% increase in the delivered capacity without requiring regeneration, recompilation, or any other processing other than definition of the database by Purchaser.

Similarly, the RTU and SIC rack shall have provision to add additional DI (224 DI) module, DO module (80 DO) to meet the site requirement.

- a. The system functions and their associated databases shall be dimensioned as per the functional requirement of the Purchaser, specified in this document. E.g., Bay augmentations, Integration of distribution level data etc.
- b. The main memory of each processor shall be capable enough to twice the delivered capacity within the delivered enclosures by Purchaser.
- c. Fifty percent of the auxiliary memory capacity of each Controller shall be completely available for future use by Purchaser. The auxiliary memory of each processor, console, and storage unit shall be expandable to twice the delivered capacity within the delivered enclosures by Purchaser.
- d. Inspection and verification, to the extent possible, that provision to upgrade and expand the system are furnished as required by the contract.

13.2 System Scenarios

The System performance shall be tested under the following system scenarios:

- a. Base Conditions
- b. Steady-State Conditions
- c. High Activity Scenario Conditions

13.2.1 Base Conditions

The following conditions shall apply:

- a. The System shall be configured with all hardware and functions required by this Specification including hardware and functions specified as optional.
- b. All System function execution parameters shall be as mentioned in this document.
- c. System functions shall execute at the periodicities and execution times specified in this document
- d. The System software and databases shall be configured in accordance with the required System Capacity.
- e. The pre-defined time change shall occur such that all data acquisition and processing associated with the time System functions, including report production, are executed.

13.2.2 Steady State Conditions

The Steady State Conditions shall consist of the Base Conditions and the following activities over a sixty-minute period:

- a. Twenty-five percent of all the analog points shall change sufficiently each time they are acquired. Sixty alarms per minute (Thirty status alarms and Thirty analog alarms) shall be generated and processed. Each of these alarms may be acknowledged within sixty seconds at Purchaser's discretion.
- b. One supervisory control sequence consisting of the opening or closing of one device shall be executed at each operation console every one minutes.

13.2.3 High Activity Scenario Conditions

The high activity scenario shall consist of the base conditions and the following activities over a fifteen-minute period:

- i. All processor inputs scanning, and processing is in progress and all the data is transmitted over the main data bus every sec
- ii. All controls in operation
- iii. Control / information request is initiated from all terminals.
- a. Hundred percent of all the analog points shall change sufficiently each time they are acquired to require complete processing by the System.
- b. A burst of 70% a COS shall be generated and processed within the first sixty seconds of the scenario.
- c. Five supervisory control sequences consisting of the opening or closing of devices shall be executed at each operating console every one minute.

13.3 System Functional Tests

The purpose of the system functional tests is to rigorously exercise all functions and to verify the correct functional operation of all hardware and software. The system functional tests shall include, but not be limited to, the following tests. The Purchaser shall also be able to perform other tests not specifically mentioned.

- a. Verification of proper data acquisition & control from the RTUs, IEDs
- b. Verification of proper data acquisition from the Multifunction Meters
- c. Verification of proper data acquisition & control from Purchaser's other condition monitoring systems.
- d. Verification of the proper response of the system to include
 - i. Loss / Restoration of IEDs and RTUs
 - ii. Loss / Restoration of Input Power
 - iii. Loss / Restoration of Communication System
- e. Verification of System Redundancy including fail-over procedures and restart.
- f. Verification of all development and maintenance capabilities Including:
 - i. Database Generation and Maintenance
 - ii. Back-up and Restoration functions of all systems.

13.4 System Response

Satisfaction of the performance requirements will be verified during factory test and the site test for each of the system and applications and the other functional requirement mentioned in the specification. Under Base Condition, Steady State Condition and High Activity Scenario Condition the system response shall be tested and response time as per the specifications shall be achieved.



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- a. All Digital Inputs shall be reported with a resolution of 1 msec.
- b. All Digital Inputs shall have individual channel reporting
- c. Supervisory control operation shall be completed, and the result displayed at workstation consoles within 1 seconds plus scan-in progress, communication, and field device operation delays.
- d. The system shall report correct Time Stamping when all process inputs scanning & processing is in progress & all the data is transmitted over Data Bus every sec.

13.4.2 Resource Monitoring

Resource utilization shall be measured, calculated and displayed for the System processors, devices, and networks. The minimum set of parameters to be presented include:

- Time utilization (percent processor utilization) of each function per processor
- Time Synchronization
- Time utilization of each function
- Data transfers per second/minute/hourly

13.4.3 System Utilization

Name	Utilization	Comments
Main Memory	30%	Normal
	50%	Peak
Processor Utilization Application processor Communication processor	<30%	Normal
	<50%	Peak
	<30%	Normal
	<50%	Peak
Local Area Networks	40%	Normal Loading
	60%	Peak Loading
Auxiliary Memory Allocated capacity Access and transfer capacity	50%	
	30%	Normal
	50%	Peak

14.0 Warranty, Maintenance, Upgrades, Patch Management & Database Modification Requirements

This Section specifies the requirements for Warranty, hardware and software maintenance for the System, Warranty maintenance and support, system upgrades, patch management etc.

Bidder to note the environmental condition of locations, the proposed system is being planned to be installed and operational.

Bidder shall provide facilities for carrying out online and offline maintenance of the components supplied as a part of the system. In general, this should include adequate testing equipment, tools, safety devices and other accessories. Bidder shall provide the details in their bid.

Bidder should provide Maintenance strategy of the product (Own & Sub-Vendor) being offered so as to schedule appropriate timeline for maintenance.

14.1 Maintenance Performance Requirement

Purchaser envisaged that all offered equipment shall not require routine or planned maintenance. Therefore, no fans or moving parts shall be used in any of the system to avoid any need for maintenance. To ensure this, all the supplied equipment should be constructed to resist the entry of Dust, Water etc. A single technician shall be able to remove and replace for repair purposes, without special tools and test equipment, all equipment involved in the offered system. Restoration of equipment to full operational use shall be possible within 15 minutes (nominally) of repairs being completed. It should not be necessary to dismantle (remove multiple pieces of) the system in order to replace a module.

14.2 Service Life

Purchaser prefers that the equipment shall be capable of complying with this standard, including performing its intended purpose, for a minimum of 10 years from the date of commissioning.

The supplier shall indicate the following:

The date at which the product was released for sale.

The anticipated date at which the product will be withdrawn from sale, but support will continue to be provided for Spares and Services.

The anticipated date that product support will be withdrawn, i.e., spares and technical support will no longer be available.

14.3 Interchangeability

All the parts/modules shall be interchangeable individually (e.g., RTU parts/modules shall be interchangeable individually, and RTU). This is applicable for all the parts/module supplied by the bidder under this contract.

Any such change or replacement shall not reduce the capability of the equipment to conform to the requirements of this specification.

14.4 Definitions

The responsibility for maintenance of hardware and software will vary depending on the time during the Contract. So that the times for changes in responsibility can be determined, the following definitions shall be used:

Delivery – Delivery of any item shall be interpreted as receipt of the item at Purchaser's facility.

Commissioning – Commissioning of any item shall be interpreted as receipt of the item at Purchaser's facility, installation on-site, successful completion of the site tests, and correction of all variances from the tests.

14.5 Deliverable Hardware and Software Version

The delivered Hardware and Software shall be the latest version being delivered by the manufacturer of the Hardware & Software six months prior to its delivery to Purchaser's facility. During delivery of the system, all the RTU of a Bidder across the TP DISCOMs network shall be upgraded to the latest version.

All hardware and software shall be of compatible versions. That is, the Bidder shall be responsible to ensure that all delivered hardware and software versions will inter-operate successfully. If it becomes necessary to upgrade some hardware or software to meet this requirement, the cost and time shall be borne by the Bidder. If it is necessary to revert to a previous version of any hardware or software to overcome incompatibilities among the hardware or software, the Bidder shall bear the cost and time of the "downgrade" and shall present a plan to correct the problems with the newer release. Such corrections shall also be at the Bidder's sole expense.

14.6 Warranty support

- a. **Maintenance services** for the supplied Hardware, System and application Software up-gradation, Patch Management services including sub-vendor products during the Standard warranty period of 5 Years from the date of system handover after SAT, resolution of all punch point of SAT and trouble-free operation of the entire system for a period of one month.
- b. Bidder shall provide Software up-gradation (if any), Patch Management services including sub-vendor products for next 5 years over and above as mentioned in item a.
- c. Training

SLA will be prepared and adhered by Bidder, Sub-Vendor's of bidder for extending the Hardware, Software and Service support to Purchaser for the period mentioned above. To mitigate major failure like Complete system failure, RTU system instability, loss or failure of any major subsystem or system component such as to cause a significant adverse impact to system availability, performance, or operational capability. Some of the salient points as example are documented below:

- a. Bidder shall report to site within 48 hours of receipt of reporting of the failure occurrence
- b. Bidder shall provide replacement of the faulty equipment within 7 days after confirmation of the fact that the equipment can't be repaired at site. Failure to this clause may have some penalty reference on Bidder.
- c. Bidder will mandatorily provide detailed analysis report of the faulty equipment within 15 days from the date of the site visit.
- d. Any spare Equipment replacement, testing and its commissioning to be done by bidder, with no cost implications to Purchaser. Any tools, equipment, Software or Hardware required for testing of the System (e.g., IEDs/RTU/Communication Equipment) will be the responsibility of the Bidder, this includes all system supplied by bidder under this contract.
- e. Any up gradation in application software and hardware will be informed to Purchaser and necessary up gradation to be carried out by Bidder with no cost implications to Purchaser.

Bidder to note that Tri-Party agreement will be prepared for Bidder, Sub-Vendor to have protection against quitting of executing bidder and its alliances during commissioning, warranty and post warranty period as specified in this document.

14.7 Hardware Maintenance

The project schedule shall include an allowance for hardware maintenance prior to the availability test. The Bidder will not be granted any relief for project delays caused by maintenance problems prior to the availability test.

14.7.1 Pre-Delivery Maintenance

The Bidder shall have the responsibility for maintenance of all hardware prior to delivery to Purchaser's site. This maintenance may be performed by a maintenance contract with Original Equipment Manufacturers (OEMs) or other parties or by the Bidder staff using spare parts from the Bidder's stores or other sources.

14.7.2 Maintenance During Commissioning

The Bidder shall have the responsibility for maintenance of all hardware after delivery and prior to commencement of the Warranty. This maintenance may be performed by a maintenance contract with OEMs or other parties or by Bidder staff using spare parts from the Bidder's stores or other sources.

Failed equipment shall be replaced or repaired, and spares inventories (if any) replenished to their delivered level throughout the period of commissioning. Any spare parts found to be defective during initial delivery inspection or during this period shall be replaced within one week after notification. There shall be no charges to Purchaser for these replacement parts, including delivery charges. All spare parts replaced under maintenance shall be new parts unless otherwise accepted by Purchaser.

14.7.3 Maintenance Under Warranty

Maintenance during the warranty shall be in conformance with the terms of the warranty sections of this RFP **(Item 14.6)**.

During the warranty period, Purchaser's hardware maintenance responsibilities will include the following:

- a. Provision of trained staff, responsible for call-out when problems occur
- b. Providing local assistance to the Purchaser during problem resolutions

The Bidder's hardware maintenance responsibilities shall include the following:

- a. Providing maintenance of all equipment, including spare parts
- b. Providing materials and instruction for appropriate engineering changes for equipment
- c. Provision of technical guidance towards the resolution of all hardware problems for equipment.

When needed, the Bidder shall respond to requests for technical support within Two Hours, 24 hours a day, seven days a week.

Failed equipment shall be replaced or repaired, and spares inventories replenished to their delivered level throughout this period. Any spare parts found to be defective during initial delivery inspection or during the Warranty period shall be replaced within one week after notification. There shall be no charges to Purchaser for these replacement parts, including delivery charges. All spare parts replaced under maintenance shall be new parts unless otherwise accepted by Purchaser.

The Bidder's technical support staff shall work with Purchaser's technical staff to establish a strategy to efficiently resolve each identified problem. If at any time, Purchaser believes that the Bidder's technical support is not effectively resolving a problem, Purchaser may request that the Bidder's system expert or

staff from the equipment's manufacturer be dispatched to Purchaser's facility. The Bidder's technical team shall be at Purchaser's facility within 48 hours of that request to provide hands-on support towards the problem resolution. Purchaser will not be responsible for any expenses connected to the technical support, including travel expenses.

The Resolution time for different complaints shall be as per the below matrix:

Category	Definition	Maximum Resolution Time
Severity 1 Urgent	Complete system failure, severe system instability, loss or failure of any major subsystem or system component such as to cause a significant adverse impact to system availability, performance, or operational capability	0-4 hrs.
Severity 2 Serious	Degradation of services or critical functions such as to negatively impact system operation. Failure of any redundant system component such that the normal redundancy is lost Non-availability of Manpower at site during working hours	0-24 hrs.
Severity 3	Any other system defect, failure, or unexpected operation. Request for information, technical configuration assistance, "how to" guidance, and enhancement requests.	0-48 hrs.

Failure by the Bidder to comply with the above-mentioned timelines, shall attract a penalty @ Rs. 1000 per hour limited to 10% of the Contract Value. Penalty amounts shall be recovered from the amounts due to Bidder or by invoking the Contract Performance Bank Guarantee submitted by Bidder against this Contract will be capped to maximum of 10% of the Contract value. Overall penalty including LD cumulatively will be 10% of the contract value.

14.7.4 Hardware Minimum Support Period

The Bidder shall guarantee the availability of spare parts and hardware maintenance support services for all System equipment for a minimum period of 10 years. Subsequent to this minimum support period, the Bidder shall provide to Purchaser a minimum of two year's advance notice of their intent to terminate such services.

14.8 Upgrades, Patch Management & Modifications

- Bidder shall continuously keep the Purchaser informed of all Software and Hardware upgrades as & when these are released.
- Bidder shall supply upgrades and patches of all installed software (both own and third party) for a period of ten years from the date of system acceptance without commercial implication.
- Bidder shall rectify all design defects and software bugs at no extra cost for a period of 10 years from the date of system acceptance.
- Bidder shall support the system totally for ten (10) years, even if no upgrades are implemented.
- Bidder shall provide lifetime support (10 years) for the system. To meet this requirement, Bidder shall refer with OEMs on the product's life cycle management and obsolescence. Bidder shall attach the product life cycle matrix for hardware and software offered under this RFP.

- f. The system referred to above includes Bidder's own as well as third party components.

14.9 Database modification during Warranty Period

All database modification major or minor (including new bay, new station inclusion and new equipment/device) is in the scope of the bidder, after the system handover and during the warranty period. The Scope covers RTU configuration and necessary changes for control center communication. It is bidder's responsibility to provide resources as and when required by the purchaser for these changes and testing of the same as per the project and planned activity schedule. One of the examples of Configuration changes/modification are as mentioned below:

- a. Addition/Deletion of 33/11 kV Bays
- b. Addition of Auxiliaries Tags
- c. Addition/ Deletion of System/IEDs/Devices/SCADA enabled equipment/sensors
- d. Reconfiguration of RTU for new Control Centers

15.0 Training

Bidder shall provide training to the Purchaser's personnel on the operation and maintenance of the system supplied equipment including non-OEM equipment/3rd Party equipment. The training shall cover development, integration, installation and commissioning of both software & hardware components of the system.

The Bidder shall provide Classroom as well as hands-on training on the offered System. All required training materials such as System Catalogues, Test Instruments, Demo Equipment, and Simulation Jigs, etc. shall be arranged by the Bidder for own and Sub-Vendor Equipment. The training shall equip the Purchaser's engineers for Installation, Commissioning, Operation and Warranty Maintenance of Hardware, Software (Operating System, Administration and Applications), protocols and all Sub-Vendor systems.

The Bidder shall prepare and deliver a comprehensive training program on the operation and maintenance of RTU, Communication equipment and associated accessories under this project. Configuration of RTU, training shall cover the skills required for the maintenance and expansion of additional feeder/IEDs/Substation. Hardware training shall qualify Purchaser to perform routine preventive maintenance, diagnostic testing on the processors, peripheral equipment, LANs & communications equipment.

Bidder shall indicate their Training facilities including test tools and simulation facilities. Bidder shall provide the training calendar and details of topics considered for the equipment offered.

The schedule, location and detailed content of each course will be finalized during detailed engineering.

Bidder to consider 20 man-days of the trainer for on-site training to Purchaser's personnel. Bidder to note that the indicated man-days will be utilized in batches, according to availability of the Purchaser's personnel.

15.1 Training Requirement

Bidder shall provide training to the purchaser's personnel on the operation and maintenance of the system supplied by him.

General requirements relating to the training are specified below:

- a) Personnel who speak understandable English and who are experienced in instruction shall conduct training courses.
- b) Classroom and Hands-on training shall be on the identical system being supplied to Purchaser.
- c) Bidder shall provide all necessary training material. Each trainee shall receive individual copies of the technical manuals and pertinent documents. These materials shall be supplied at least one month before the scheduled commencement of the training course.
- d) The purchaser shall be permitted to video tape all training classes.
- e) Class materials, including documents sent before the training classes and class handouts, shall become the purchaser's property. The purchaser may copy this material for in-house training and organization use only.
- f) Training sessions conducted at site shall accommodate the number of candidates in batches.
- g) Bidder to note that, requirement of Training for RTU system is explained in detail, on similar line bidder to arrange training for all non-OEM systems such as Ethernet Switch etc.

15.1.1 Course Descriptions

Course descriptions shall be included with the training plan that shall provide the following information for each course included in the training plan:

- a) The course name (and number if applicable)
- b) A brief description of the course
- c) A description of the intended audience for the course
- d) A description of the relation of the course to others in the training plan
- e) The duration of the course
- f) A breakdown of the course schedule, identifying classroom and hands-on periods
- g) A list of the training materials to be supplied
- h) A list of reference material to be used in the course
- i) A list of any prerequisite training or experience expected of the students.

At Purchaser's request, the Bidder shall provide a description of all courses offered by the Bidder and its Sub-vendors.

15.2 Training Curriculum

The training curriculum presented in this section is intended to describe the contents of the training when viewed. The subjects covered by individual courses may differ as long as the overall objectives are satisfied.

15.2.1 RTU Hardware Training

RTU system hardware course shall be designed to provide Purchaser's personnel enough knowledge of the overall design and operation of the system so that they can correct obvious problems, configure the

hardware, perform preventive maintenance, run diagnostic programs, and communicate with OEM personnel. The following subjects shall be covered:

- a) Configuration of the System Hardware.
- b) Basic and advance training of operation, maintenance techniques and diagnostic procedures for each element of the offered system, e.g., Processors, Auxiliary Memories, LANs, Routers etc. Configuration of all the hardware equipment.
- c) Techniques and procedures to expand and add IEDs/Feeder/Substation/Communication channels etc.
- d) Theory of operation and maintenance of the redundant hardware configuration, failover hardware, configuration control panels, and failover switches. Maintenance of protective devices and power supplies.
- e) Theory of design and operation, maintenance techniques and practices, diagnostic procedures, and (where applicable) expansion techniques and procedures. Course content shall include hands-on training for the specific subsystems that are part of Purchaser's equipment or part of similarly designed and configured subsystems. All interfaces to the computing equipment shall be covered in detail.
- f) Preventive and Corrective maintenance of all equipment, including use of special tools and instruments.
- g) Capable to diagnose and debug problem in the RTU. Course should familiarize the different error code of the RTU and how to rectify them.

15.2.2 **System Software Training**

The Bidder shall provide a System Software course that covers the following topics:

- a) All applicable programming languages, Stand-alone Service and Utility packages of the system. An introduction to software architecture, effect of tuning parameters (OS software, Network software, database software etc.) on the performance of the system.
- b) Operating System course consisting of the user aspects of the operating system, such as program loading and integrating procedures; scheduling, management, service, and utility functions; and system expansion techniques and procedures.
- c) System Initialization and Failover, execution of diagnostic procedures and the interpretation of diagnostic outputs.

15.2.3 **Application Software Training**

Comprehensive application software course, covering all applications database Logic and display building etc. The training shall include minimum the following:

- a) Overview of the application software and data flows.
- b) Programming Standards and Interface conventions.
- c) Functional capabilities, design, and major algorithms. Associated maintenance and expansion techniques.
- d) Software development techniques and conventions for the preparation and integration of new software functions.
- e) Generation of application software

15.2.4 **RTU Configuration/Engineering Training**

The database and logic building course shall cover how to configure the inputs & outputs signals of the RTU, communications with IED, communication with Control Centre, build the configuration database,

storing and retrieving of the configuration file, database administration to maintain and modify the database and its structures. Following minimum topics shall be covered:

- a) How to set up configuration database for RTU, identifying different component for configuration
- b) How to configure I/Os
- c) How to configure IEDs
- d) How to configure Control Centre Communication
- e) How to Configure Cyber Security features of RTU
- f) How to Compile Configuration
- g) How to Import / Export configuration file
- h) How to download/upload configuration file
- i) How to maintain different configuration file

15.2.5 RTU System Administration

System administration course shall cover the procedures necessary to operate the RTU configuration software, managing users and their roles. At the end of this course, participants shall be able to:

- a) Start up the RTU configuration Tools and its components
- a) Shut down the Software and its components
- b) Switch functions to backup equipment
- c) Take equipment out of service and its restoration
- d) Interpret and react to messages generated by error-monitoring functions
- e) Test field device and communication links
- f) Implement procedures for installing new devices
- g) Use procedures for altering and replacing the configurations
- h) Identify procedures for using diagnostics
- i) Describe the backup functions required for normal maintenance
- j) Upgradation of System Software, Patch Management and Firmware Upgradation of OS and Application Software etc.

15.2.6 Simulator Training

This course shall cover the operation of the Simulator, scenario building, and maintenance. Enable the Purchaser personnel to:

- a) Prepare training scenarios using the scenario building tools
- b) Simulate the communication over IEC 61850 protocol with devices
- c) Simulate the communication over IEC 60870-5-104/101/103 and Modbus protocol

Similarly, the bidder shall arrange training on Sub-vendor equipment supplied under this RFP.

16.0 Tools Tackles for Erection & Commissioning

Bidder to consider and supply special tools and tackles (Hardware and Software) required for erection, commissioning, and maintenance of the offered system. After commissioning of the system all tools and tackles shall be handed over to Purchaser's Project/Maintenance team.

All tools (both hardware and software), test instruments, simulation jigs, documents, programming equipment etc. required for Installation, Testing & Commissioning are in the scope of the bidder.

All configuration cables and other specialized testing passive devices to be provided with the supply of material.

17.0 Spares

- a. Bidder needs to include competitive price for Mandatory Spare parts against the below specified list and schedules.
- b. Bidder shall include list of spares with quantities as recommended by him required for 10 years trouble free operation of equipment.
- c. The spares supplied shall be strictly interchangeable with parts for which they are intended for replacement.
- d. The spares shall be treated and packed for long storage (minimum 10 years) under the climatic conditions prevailing at the site.
- e. The start-up spares shall be delivered at the site well in time before the start-up and commissioning of the system.
- f. Bidder to note the environmental condition of locations, the proposed system is being planned to be installed and operational.

17.1 Start-Up Spares:

The start-up spares are those spares which will be required during start-up and commissioning of the equipment/systems, and until Final Take Over. It is the responsibility of the bidder to supply all the necessary spares as required until the equipment/systems are handed over to the Purchaser. An adequate stock of start-up spares shall be available at the site such that the start-up and commissioning of the equipment/systems, performance testing and handing over the equipment/systems to the Purchaser be carried out without hindrance and delay. All start-up spares which remain unused after the taking over the system shall remain the property of the Purchaser. The Bidder shall furnish the Schedule of Start-up Spares.

17.2 Mandatory Spares

Essential spares are those considered necessary by the owner for ten (10) years of normal Sub-Station Automation System operations. A list of such spares has been listed in the below mentioned table and the same shall be included in bidder's scope. When an item of spares is indicated as 'percentage', it shall be considered as percentage of total number of that item of spares of overall project, unless specified otherwise and the fraction shall be rounded-off to the next higher whole number. Whenever the item of spares has been indicated as 'set' the same shall mean the supply for a single equipment/system. One set of spares for the particular equipment shall mean the total quantities of that particular spares for a single equipment e.g., 'set' of RTU, SIC etc. The 'set' shall however include all components required to replace

that item of spares. The Owner reserves the right to buy any of the essential spare parts as considered necessary.

In case during start-up and commissioning certain essential spares are used up, the same shall be replaced within one (1) month without any commercial implications.

Bidder shall furnish details for all essential spares as per the approved vendor document list.

Bidder to consider following mandatory spares in the offer.

Mandatory Spares		
System	UoM	Qty
RTU Rack without panel as per Proposed Solution with all Application s/w, CPU & Comm Modules, licenses, accessories, cables etc.	Sets	5%
RTU Chassis	Nos.	5%
CPU Module (along with licensed SD card if applicable) of the RTU	Nos.	5%
Power Supply Module of the RTU	Nos.	10%
Communication Module(along with licensed SD card if applicable) (Ethernet)	Nos.	5%
Communication Module(along with licensed SD card if applicable) (Serial)	Nos.	5%
DI Cards with Interface Module & Cables for Digital Inputs	Sets	5%
DO Cards with Interface Module & Cables for Digital Output	Sets	5%
AI Cards with Interface Module & Cables for Analog Inputs	Sets	5%
Any Other Modules Specific to OEM Solution	Sets	2%
Managed Ethernet Switch – as per proposed solution	Sets	8%
CMR Relay with Base as per proposed solution	Nos.	5%
HDR Relay with Base as per proposed solution	Nos.	5%
Diode OR-ing Unit (If Applicable)	Nos.	2%
Fluke 362 Clamp Meter 200A AC/DC Clamp Meter	Nos.	1
RISHABH AET 23 Smart Digital Earth Tester	Nos.	1

Note: Bidder to note that all above equipment shall be supplied along with Power supply, communication and specialized cables (if any)

Spares mentioned above shall be same as of installed system with necessary software key and licenses.

The table above indicate the minimum requirement of the owner, bidder to include 5% spares, which are not part of this table, but required for maintenance and upkeep of the system.

17.3 Recommended Spares

In addition to the spares mentioned above, the Bidder shall also furnish in his bid a list of recommended spares which may be required for ensuring the availability during the guaranteed availability period with unit prices. The final list of spares shall form part of scope of supply and accordingly the price thereof shall be quoted by the bidder and shall be considered in the evaluation of the bids. The Purchaser reserves the right to buy any of the recommended spare parts as considered necessary by him. The prices of recommended spares shall be consistent with those of start-up/essential spares. Purchase of these spare parts will be covered under this order / by a separate order / an amendment to the contract.

The Bidder shall provide a list of recommended spares for a period of Ten (10) years from the date of handover of the project to Purchaser. The shelf-life of these spares is such as to last for at least Ten (10) years from the date of handover of the project. Spare parts supplied by the bidder shall be made available to the bidder for usage subject to replenishment at the earliest (within a month). Thus, at the end of every quarter the inventory of spares with the Purchaser shall be fully replenished by the bidder. However, any additional spares required to meet the availability of the system (which are not a part of the spares supplied by the bidder) should be supplied immediately by the bidder free of cost to the Purchaser. The list shall include the following:

Sl. No	Item Part Description	Recommended Quantity	Procurement Lead Time	Quantity of item held in Local office of Bidder	Quantity of item held in Head Office of Bidder as an emergency spare	Unit Price	Total Price

The Bidder shall provide the MTBF of various components, sub-assemblies, assemblies etc. (recommended as spares) and the relationship between MTBF and spare quantities recommended. The bidder is required to list the spares.

The Bidder shall submit the product life cycle details of all the hardware offered under this RFP.

End of Section-A

Section – B

Detailed Technical Specifications

Revision	Date	Description	Approvals		
			Prepared By	Checked By	Approved By
R0	5 th Apr 2025	Released for Procurement	TPC ^{ODL}	TKB/GM/SJ	VC

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Chapter # 1

RTU Specification

The Intent of this specification is to implement Substation Automation System for 33/11 kV Primary Conventional Substations and its integration with MCC and BCC of Purchaser's SCADA/ADMS System .
The proposed Remote Terminal Unit (RTU) shall facilitate Remote Monitoring and Control of 33/11 kV Primary Conventional Substations from the SCADA/ADMS System at MCC and BCC over IEC 60870-5-104 protocol.

1.0 Remote Terminal Unit (RTU)

RTU is envisaged for data acquisition and integration with control centers to carry out remote monitoring and control of the Substation. A state-of-art microprocessor based industrial RTU designed for the electrical process environment in both decentralized and centralized manner shall be considered. The RTU shall guarantee high availability and ensure safe and secure operations of all substation equipment.

The RTU shall be multifunctional, designed in accordance with applicable International Electro-Technical Commission (IEC), Institute of Electrical and Electronics Engineer (IEEE), American National Standards Institute (ANSI), and National Equipment Manufacturers association (NEMA) standards, unless otherwise specified in this Technical specification. In all cases, the provisions of the latest edition or revision of the applicable standards in effect shall apply.

RTUs shall be redundant to provide a reliable system for acquisition of required information from the RTUs, BCPUs, Numerical relays, Multifunction meters, Condition Monitoring Devices, and other communicable devices as well as hardware signal through I/O cards.

All functional capability described herein shall be provided by the bidder even if a function is not initially implemented. As a minimum, the RTU shall be capable of performing the following functions:

- 1.1 The proposed RTU shall be suitable for decentralized and centralized architecture to address the requirement of present and future.
- 1.2 The proposed RTU, I/O and Interfacing modules shall be of the same family of RTU or Embedded, industrial grade system with high availability & reliability. RTU hardware shall be easily scalable for expansion and to integrate IEDs in future on open protocols.
- 1.3 The RTU shall be redundant in hot standby mode with bump less Auto Changeover.
- 1.4 RTU shall have vast protocol support capability, adaptable for customization and additional protocols and Multi master communication capability.
- 1.5 The RTU shall support a wide range of protocols including IEC61850 Client (ED1 & ED2 edition), IEC 60870-5-104 (Master/Slave), IEC 60870-5-103 Master, Modbus – RTU Master, Modbus - TCP/IP (Master).
- 1.6 The RTU shall have min 10,000 Data points and shall support integration of at least 25 IEDs on IEC 61850 and at least 25 IEDs on Serial Protocols. Bidder to consider the hardware such as I/O peripheral, Serial Ports, Communication processors, Converters etc., in the RTU accordingly.

- 1.7 The proposed RTU shall communicate simultaneously with eight independent remote master (redundant) stations on IEC 60870-5-104 Protocol.
- 1.8 RTU to the Purchaser's SCADA Systems shall allow scanning & control of all defined points (Physical/Pseudo points) within the substation independently to each of the SCADA systems. Proposed system shall simultaneously respond to independent scans & commands from Purchaser's SCADA/ADMS Systems. Proposed system shall support the use of a different communication data exchange rate (bits per second), scanning cycle, and/or communication protocol for each remote-control centre. In addition, each control centre's data scan and control commands may be different for different data points within the proposed system's database.
- 1.9 It is preferred that the RTU shall be Din Rail Mounted.
- 1.10 Shall support IEC 61131 based programming logic. The RTU shall support programming language (Functional Block) with arithmetic & logical functions to incorporate Interlock Logic for SCADA Controls. Bidder to ensure supply of necessary hardware and software to achieve the functionality.
- 1.11 Secured Web Server functionality to monitor and configure the RTU along with AAA security functionality.
- 1.12 Should provide latest Microsoft Windows based maintenance and configuration tools. The tools should have functionality of both remote and local access.
- 1.13 Time synchronization based on SNTP (Server/ Client) and Protocol specific synchronization (IEC 60870-5-104 etc.). The RTU shall accept minimum two independent sources for time synchronization over SNTP or data communication Protocol specific Synchronization. RTU in turn shall synchronize the IEDs integrated on different protocols.
- 1.14 RTU shall support SNMP protocol for device monitoring and management from Purchaser's Network Management System.
- 1.15 RTU shall support configuration File Upload and Download from the Engineering Station (Configuration Laptop), functionality shall support both Local & Remote configuration.
- 1.16 RTU shall be capable of acquiring 32-bit analog and accumulator data from multi-function meters on MODBUS (RTU & TCP/IP)/IEC61850 (Ed.1 &2)/IEC60870-5-104.
- 1.17 RTU communication protocol shall be configured to report analog & Status changes by exception to master stations. However, RTU shall support periodic reporting of analog data and periodicity shall be configurable from 1 sec to 1 hour. Digital status shall have higher priority than the analog data. In addition, analog values shall also be reported to Master station by exception on violation of a defined threshold limit.
- 1.18 The XML based Substation Configuration Description Language (SCL) of IEC 61850 configuration interfaces shall allow information to be shared between the various configuration tools, reducing the overall engineering time.

- 1.19 User friendly on-line health and data monitoring facility shall be provided to maintenance engineer for monitoring/analyzing the real time status of the process, program logic from the engineering station (Configuration tool – Laptop) from Local and Remote.
- 1.20 The system shall comprise of features namely failsafe control (i.e. check-before-execute, selection timeout etc.), Interlock & Sequential Logic Control system, Sequence of Event Recording (SER), Interfacing with third party IEDs (e.g. Multifunction Meters, Condition Monitoring & Protection system etc.), interfacing with third party computer system, Integration of data as per time base (e.g. 15 minutes energy integration), direct GPS clock connectivity, through SNTP server or through the Master (Main & Standby) for time synchronization.
- 1.21 In case of power supply failure, auto start-up and restoration of the RTU shall be possible without manual intervention. It is also intended that SOE buffered just before switching off the RTU shall be reported to the Master immediately after restoration of power supply without any loss of data.
- 1.22 All the cards/modules of the RTU, Ethernet Switch etc. must have conformal coating for protection against harsh environments. Standard technic and material shall be used for conformal coating. Conformal coating should not result in any malfunction of the RTU or heating of any component.
- 1.23 It shall be possible to increase the number of communication ports in the RTU by addition of modules, if required in future. The RTU shall support the use of a different communication data exchange rate and scanning cycle on each port and different database for each master station.
- 1.24 Internal battery backup to hold data in SOE buffer with time & date and running of the clock in case of failure of supply.
- 1.25 The proposed RTU shall be DNV GL (Formerly KEMA Lab) Certified or by equivalent certification body like NABL/CPRI/International Accredited Lab for environmental parameters as per IEC61850-3 and communication protocol profile of IEC 60870-5-104. IEC 61850 protocol.
- 1.26 It shall be capable to perform all functions for entire substation including future requirements. Processor & RAM shall be selected in such a manner that during normal operation not more than 30% capacity of processing & memory are used.
- 1.27 RTU shall communicate to MCC, BCC system over IEC60870-5-104 protocol and should support minimum 8 independent Masters on IEC60870-5-104 protocol.
- 1.28 Continuous self-supervision function with self-diagnostic feature shall be included.
- 1.29 RTU & Communication Redundancy
 - The RTU shall be redundant with all functionalities, so that the RTU can communicate with the Remote Control Centre, even when one of the units fails.
 - The failover process should cause the assignment of all the functions of the failed unit to the healthy unit. The changeover between the two redundant units shall be seamless and shall not require any manual intervention. The changeover process of the RTU shall be bump less and with no data loss.

- Main and Standby RTU shall support all functionalities independently i.e. all Substation IEDs and Communication to Control Centre. Failover should take place in case of failure of the unit and failure of any communication channel.

1.30 Communication

1.30.1 Ports

-
- Each CPU card shall have atleast 2 ethernet ports for simultaneous communication on 61850, IEC60870-5-104, Modbus TCP protocol & other Ethernet based protocol and 4 RS485 port for serial devices communication like, battery charger, FDS, WIT/OTI, ACDB on Modbus RTU and other serial protocol. If 4 serial ports are not available in one card then the same can be achieved with additional card with redundancy.
- Second CPU will be redundant of the first CPU and shall have same configuration of the first CPU card.
- Serial ports will be used for communication of battery charger, FDS, WIT/OTI, ACDB etc. in redundant connection with the main and redundant CPU. In case of change over, seamless changeover will take place.
- Other Ethernet ports with for simultaneous communication with IEDs (IEC61850 ED1, ED2), Modbus TCP and other ethernet based protocol.
- All the serial devices of the substation shall communicate to main and standby RTU. In case of change over there will be no loss of data.
- In addition to above, Ports for internal communication, maintenance and configuration shall be considered.

1.30.2 Protocols

- The communication protocol of RTU to Master Control Center must be IEC 60870-5-104 protocol.
- IEC 61850 Client Ed.1 & 2, IEC 60870-5-104 Master & Slave, IEC 60870-5-103 Master, MODBUS Master (Serial and TCP/IP) shall be supported. The proposed RTU is deployed in distribution substations and running successfully integration with all reputed vendor's protection and control devices over IEC 61850 protocol.
- Time synchronization over SNTP and Communication protocol on IEC60870-5-104 from Master.
- Should generate XML file for integration/engineering with vendor Independent SCADA systems
- RTU shall be RSTP compliant for communication redundancy.
- SNMP (v1, v2c and v3) for Health monitoring of the Hardware.

1.31 Input / Output Requirement

- a. Hot replacement of all I/O modules
- b. A complete set of process interface
- c. High disturbance immunity, meeting the requirements of the IEC directives 89/336/EEC and 73/23/EEC when placed in cabinets.
- d. Comprehensive self-diagnostics
- e. On-board processing capabilities such as time-tagging, event handling, filtering and gain control.
- f. Modularity, permitting step-by-step expansion
- g. Reliability and auto-diagnostics
- h. Easy to configure
- i. Quick fault finding with help of LEDs of each module and channel
- j. The relative time error between events (DI signals) handled within the controller shall be <1 ms (interrupt driven). The relative time error between events handled within RTU shall not be more than 2 ms.
- k. Input / Output Requirement for each Substation: Typical Input/Outputs requirement

33/11 kV Substation	Digital Inputs (DI)	Digital Output (DO)	Analog Input (AI)
IO configuration Proposed	16	8	4
Expandable	48	24	8

The following Input / Output modules are envisaged to acquire the field information. Bidder to note that, the I/O requirement considered from hybrid architecture, i.e. Acquisition of I/O from IEDs and as well from proposed I/O modules.

- a. Analog input
- b. Digital inputs
- c. Digital outputs

1.31.1 Analog Input Sub System

- The entire analog, Telemetered, Non-Telemetered and calculated point values shall be stored in the database in engineering units
- The system shall provide the capability to perform analog-to-digital conversion accuracy monitoring and raising an alarm should any such points exceed tolerance

a. Analog Signal Conditioning

- Galvanic isolation of input and output signals
- Input filtering and non-linear filtering for attenuation of noise-level

- Amplification of low-level signals
- Cold junction compensation

b. Analog Signal Monitoring

- Power supply failure monitoring due to loose plug connection, short circuit, wire break and voltage interruption
- Transducer / Energy Meter monitoring for parity, wire break, live zero and end limit values
- Short circuit proof
- Monitoring of A/D conversion
- On-line simulation
- Cable monitoring for open circuit
- Fuse protection and fuse failure detection
- Communication monitoring
- Configurable Dead band

c. Design and Performance requirement of Analog Input modules

The Analog Input module shall be a solid-state type. The following features shall be provided:

- The decoding logic shall ensure that no two channels are selected simultaneously
- Cross-Talk attenuation between selected and unselected channel shall be more than 80 dB
- The Analog – to – digital converter (ADC) shall preferably be of successive approximation type, the following feature shall be provided:
 - Guarded input section to ensure large common mode noise rejection
 - Provisions for ADC overflow detection
 - Repeatability of +/- 0.025% of full scale
- The following design features shall be provided to offer protection to the analog input modules:
 - Protection for continuous overload up to 200% of all input ranges. Such overload on any analog input point shall not affect the accuracy of the next analog input in the same range.
 - Features to ensure that power line voltage variations up to +/-20% and line frequency variation up to +/- 10% do not affect the accuracy of the system
 - Connection of any point for indefinite time shall not damage the system
 - Provision for isolating failed channels and for ensuring that such partial failure does not affect remaining healthy channels

- Modular design to enable easy field expandability
- Provision for two high accuracy reference voltages to be used for checking the accuracy of the ADC for linearity, zero drift and gain. The reference voltage shall be set at equal intervals with respect to the ADC range. This check shall be made automatically at periodic intervals not exceed 6 secs and shall be alarmed if conversion is out of tolerance
- On-line replacement of individual modules in case of failures
- Surge withstands capability as per IEEE standards.
- Measurement range: +/- 2.5 V, +/- 5 V, +/- 10 V, 0-+/- 5 mA, 0-+/- 10 mA, 0-+/- 20 mA, 4-20mA
- Resolution: 14 bits + sign
- Type of input: Differential
- Input impedance (Voltage input) – 2 Megaohms
- Shunt resistance – 250 ohms
- Common Mode Voltage – 100 V
- Conversion time - < 100 millisecond
- Fusing of Transducer Supply – Individual
- Temperature drift with Gain=1 - 0.05%/10°C (Typical), 0.1%/10°C (Max)

1.31.2 Digital Input Sub System

Digital input with memory shall be considered in case when two items of information received simultaneously i.e. the current point state and flag indicating if the state has changed more than once since the last scan cycle. Number of changes shall be computed using the new state, the memory flag & the last state.

a. Digital Input Signal Conditioning

- Galvanic isolation of input signals
- Input filtering for noise-level

b. Digital Input Signal Monitoring

- Contact monitoring
- Contact bounce protection
- Power Supply failure
- Fail safe condition on failure of card / channel
- On-line simulation / blocking

- Fuse protection and fuse failure detection
- Communication monitoring
- Cable monitoring

c. Design and Performance requirement of Digital Input modules

The digital input modules shall be provided for the periodic scanning of both low resolution and high-resolution digital inputs. The following design features shall be provided:

- Internal voltage source to convert contact state of potential free contacts, either changeover or ON-OFF into logic level signals. Possibility of surface film or contamination on the contacts shall be considered while selecting this source
- Voltage level sensing units, with non-zero values for the binary status output
- Differential input circuit to offer common mode isolation
- Choice of polarity and threshold range
- Buffer registers
- Filtering to protect against contact bounce or electrical noise on input lines
- Detection of card power supply failure
- Surge withstands capability as per IEEE standards
- Self-Checking features for detecting faulty operation
- Status indicating LEDs for each input
- On-line replacement of individual modules in case of failure
- Simulation facility
- Digital inputs with interrupt-controlled updating
- Provision for isolating failed channels and for ensuring that such partial failure does not affect remaining healthy channels
- The digital input can be inverted so the value is 1 when the electrical signal is off, and 0 when it is on
- Rated Voltage – 24 V DC / 48 V DC
- Input Voltage Range “1” – 18 – 30 V/ 36 – 72 V
- Input Voltage Range “0” – (-) 28 – 10V / (-)28 – 20 V
- Input Resolution – 1 mSec
- Time Stamping – at Card level
- Event Detection – Yes

- Current consumption (+5V) – 460 mA
- Number of channels per module / card – 16 (max)

1.31.3 Digital Output Sub System

a. Digital Output Signal Conditioning

- Galvanic isolation of output signals

b. Digital Output Signal Monitoring

- Contact monitoring
- Contact bounce protection
- Power Supply failure
- Fail safe condition on failure of card / channel
- On-line simulation / blocking
- Fuse protection and fuse failure detection
- Communication monitoring
- Cable monitoring

c. Design and Performance requirement of Digital Output modules

The digital output module shall provide contact closure outputs by driving relays. The features to be provided are as follows:

- On-line replacement of individual modules in case of failure
- Long life, bounce free, high-speed mercury wetted or dry reed relays
- Surge withstands capability as per IEEE standards
- Type of Output – Opto isolated short circuit protected transistor output
- Number of channels per module / card – 32 (max)
- Voltage rating – 24 V DC /48V DC
- Load Supply – 19.2 V (minimum), 56 V (maximum) / 38.4 V (Min),112 V (Max)

1.32 Algorithm and Logic

- a. The RTU shall be based on advanced and proven algorithms and an easy and efficient upgrade of the RTU functionality shall be possible.
- b. The RTU shall support IEC61131 for constructing the interlock logic functions.

- c. The RTU shall facilitate user defined logic functions such as automatic control sequences by means of available logic elements. e.g., with one command perform a safe change of the connection of a selected line from one bus-bar to another bus-bar in double bus-bar switchgear.
- d. Command is always to be given in two stages: selection of the object and command for operation under all mode of operation. Final execution shall take place only when selection and command are actuated (Select-before-execute).
- e. It shall also be possible to interconnect and derive input and output signals, logic functions, using built-In functions, complex voltage and currents, additional logics (AND-gates, OR gates and timers).
- f. A delay/integrator shall allow the pick-up and reset of binary signals of IEDs to be delayed before being displayed or used to control other functions.

1.33 Self-Supervision

- a. The RTU shall have extensive self-supervision including all functional module and communication channel.
- b. The RTU shall have LEDs for healthiness / error indication
- c. RTU shall have the facility to generate & download the log files for maintenance and troubleshooting.
- d. Each RTU shall be independent from each other and its functioning shall not be affected by any fault occurring in any of the equipment of the station.
- e. Command execution timer (configurable) must be available for each control point. If the control action is not completed within a specified time, the command should get cancelled (Run Time Command cancellation). The timer for time-out feature shall also be user configurable.
- f. In case of restoration of communication links, power supply after failure, the software along with hardware shall be capable of automatically synchronizing with the remaining system without any manual intervention.
- g. It shall be possible to re-boot the RTU through the LAN/WAN from a remote location.

1.34 Event Recording pertaining to RTU

- a. The RTU shall support event recorder that can handle up to 2000 time tagged events. Events shall be stored in non-volatile memory. In case of failure of RTU or communication channel, the recorded events shall be communicated to the master as soon as communication is restored after failure.
- b. The RTU shall have an internal clock with the stability of minimum 10 ppm or better. The RTU time shall be set from time synchronization messages received from GPS clock or Master station. SOE time resolution shall be 1ms or better.
- c. The RTU shall maintain a clock and shall time-stamp the digital status data. Any digital input data in the RTU shall be assignable as an SOE point. Each time a SOE status indication point changes the state, the RTU shall time-tag the change and store in SOE buffer within the RTU. SOE shall be transferred to Master Station through RTU as per IEC 60870-5-104 protocol.

- d. It shall be possible to retrieve the recorded event on the Purchaser's SCADA system.

1.35 **Power Supply**

- a. The RTU shall be powered from the 18-72 VDC (24/48 V DC) Power Supply. The RTU shall accept power from the DC system with the following characteristics:
- b. Bidder shall consider Dual Input Source for energizing the RTU along with Diode-oring unit.
- c. Nominal Voltage of 24V DC/ 48V DC with operation between 18 - 72 VDC. The voltage may vary during normal operation between these limits with a duration not less than 1 msec.
- d. Reverse polarity protection.
- e. The RTUs shall operate with grounded input power from purchaser
- f. The RTU shall have adequate protection against reversed polarity, over current and under voltage conditions.
- g. Each Input / Output Supply within the panel shall be through power supply distribution module with MCBs with NO contacts (for supply monitoring).

1.36 **Time Synchronization**

- a. RTU time synchronization shall be through GPS clock via communication ports on SNTP or over the Communication protocol from master (IEC 60870-5-104).
- b. RTU in turn shall be capable of synchronizing all the slave IEDs
- c. Timing Accuracy: The RTU shall time-tag event reports to an absolute accuracy of 1ms or better.
- d. RTU shall generate an alarm if it gets drifted or loose the synchronization signal.
- e. RTU shall have min 2 (two) source input for Time synchronization with priority provision
- f. Bidder to propose the solution for time synchronization of the RTU, if the same drifts beyond specified limit (e.g. 30 minutes drift)
- g. With each power cycle the RTU shall synchronize with GPS receiver or with Master.

1.37 **Environment requirements, Reliability & Cooling**

- a. The Unit shall have high reliability in operation and shall not use cooling fans. The unit shall have vermin proof enclosure and shall insulate electronics, internal components and electronics from external environment in order to avoid failures due to dust, humidity, fungus etc.
- b. The RTU Panel hardware installed shall comply to IP54 or better enclosure.
- c. The RTU panel shall be installed in Substation control room buildings with no temperature or humidity control. RTUs shall be capable of operating in ambient temperature from 0 to +65-degree C with rate of temperature change of 20-degree C/hour and relative humidity 95%, non-condensing.

1.38 **Expansion in future**

Offered system shall be suitable for extension in future for additional BCPUs & other IEDs. During such requirement, all the drawings and configurations shall be designed in such a manner that the Purchaser shall easily perform its extension. During such event, normal operation of the existing substation shall be unaffected, and system shall not require a shutdown. The Bidder shall provide all necessary hardware and complete set of software tools along to perform addition of bays in future and complete integration with Purchaser's SCADA System. These hardware and software tools shall be able to configure IED, add additional analogue measurements, digital I/Os, modify interlocking logics etc. for additional bays/equipment which shall be added in future.

1.39 Cybersecurity

- a. Secure access- Role Based Access Control (RBAC) : User with proper role and authority shall be configurable for configuration and access of the RTU. Each user shall have proper user Id & secured Password complexity.
- b. User Credentials to access RTU shall be authenticated through Purchaser's Active directory Server.
- c. All actions/modifications/deletions shall be logged in the RTU. These logs shall be pushed to Purchaser's Central Asset Management system/SOC.
- d. It shall be possible to access the RTU through a secured web browser (Https Support) anywhere from the LAN for configuration, diagnosis, monitoring, file upload & download, simulation and log retrieval by using appropriate user account management.
- e. The RTU should also supports Authentication and Authorization of individual users, Security logging.
- f. The RTU shall support integrated crypto-chip and IP Sec encryption.
- g. The RTU shall support secured IEC60870-5-104 communication with master.
- h. RTU shall be NERC-CIP/NIST 7628, IEC62351, IEC 62443 and IEEE 1686 compliant.
- i. RTU shall be enabled with System hardening viz. disabling/removal of unused ports and services.
- j. RTU Should support System Audit Logs, SYS logs etc.

1.40 Reliability

Reliability of the equipment's offered shall be better than 99.99% per year availability for overall end equipment. RTU reliability and availability calculation shall be provided with engineering document for approval.

1.41 Signal Expansion in Future

Offered system shall be suitable for extension in future for additional I/O requirement. During such event, normal operation of the existing substation shall be unaffected, and system shall not require a shutdown. The Bidder shall provide all necessary hardware and complete set of software tools along to perform addition of bays in future and complete integration with RTU System. These hardware and software tools

shall be able to add additional analogue measurements, digital I/Os etc. for additional bays/equipment which shall be added in future.

1.42 Engineering Station (Laptop)

Engineering LAPTOP shall be industrial grade LAPTOP system loaded with software for RTU configuration, diagnosis, simulation, Logic development in RTU Also, shall be loaded with configuration and management software of RTUs, BCUs on IEC 61850 LAN.

A tool for user friendly engineering and disturbance handling shall be available.

- a. Engineering laptop shall have SSD hard disk (Minimum 1 TB). Refer BOM for the configuration.
- b. Configuration of all input and output logical, communication interfaces and other built-in functions and signals shall be possible both locally and remotely from the Master Station for configuration & maintenance activity.
- c. Configuration application shall have multilevel passwords to safeguard control, logic, and automation settings.
- d. Data collection, data modelling, configuration and parameter setting
- e. Engineering of process information for automation and control center systems
- f. Engineering of process information for automation of non-bidder systems and their individual parameters.
- g. User friendly on-line monitoring facility of real time data shall be provided to maintenance engineer for monitoring/analyzing the real time status of the process, program logic from the engineering station.

1.42.1 Configuration Application

- a. SCL Tool shall be used to model the (IEDs) as stipulated in the standard IEC 61850. SCL Tool shall be capable of generating the configuration files for the RTU from the ICD files of the BCPUs/Relays of different manufacturer .
- b. The main functions that the application shall perform are:
- c. Read and edit any type of configuration file compliant with the defined restrictions by the schema of the SCL language.
- d. Model devices from the libraries of Logical Nodes (LNs), Common Data Class (CDCs) and Common Data Attributes (CDAs) defined in the norm.
- e. Generation of the modelling and SCL configuration files for devices IEC 61850.
- f. Capacity to manage projects with several devices, generating the files for the configured devices.
- g. Visualization and edition of the components of the standard library of the norm. This can be customized with user additions or generate custom libraries for specific projects.
- h. Export files of data templates (Data Type Templates) that can be reused to model new devices. This avoids the need to create all these sections in new models.

- i. Compatible with IEC 61850-6 Ed:1, Ed:2, and other associated models like IEC 61850-7-410, IEC 61850-7-420
- j. Create SCD / SSD / SED / ICD /CID/ IID SCL Files
- k. Import & Export of SCD / SSD / SED / ICD / IID / CID SCL Files
- l. Facilitate enhanced management of SCL files and its validation
- m. Wizard for handling major process and work flow
 - SLD Wizard: to draw and add Substation Configurations to the Project
 - IED Configuration Wizard: to add and edit IED Configurations to the project
 - SCD Wizard: to add external SCDs /SEDs to the Project
- n. Library Support
 - SLD library support for reusing substation drawings in multiple projects
 - Data model library as per IEC 61850-6 Ed:1 and Ed:2
 - Flexible design that enable user to create & edit data model library

1.42.2 RTU/IED simulator & protocol analyzer software tool

- a. RTU simulator tool shall be provided to test the communication interfaces of Master station, RTU, RTU and IEDs.
- b. The Master station simulator tool shall be capable of emulating the master station on open protocol such as IEC 60870-5-104, 101, 103, Modbus, & IEC61850 etc. The RTU simulator shall also be capable of emulating the slave protocols for all the applicable open protocols. Bidder shall submit the details of the offered simulator packages along with the bid.
- c. The protocol analyzer shall be used to monitor all communication traffic on a channel (between Master station & RTU/RTU & between RTU/RTU & IEDs without interfering channels operation. Channel traffic captured in the active or passive modes of operation shall be displayed.
- d. The Master station simulator and protocol analyzer tool shall be provided and shall have following features:
 - Each received message shall be checked for validity, including the check sum.
 - The tool shall maintain and display error counters so that the number of errors during a period of unattended testing can be determined.
 - All fields of a message shall be displayed. A pass/fail indication for the message shall be included.

1.43 Layer 2 Industrial Grade Managed Ethernet Switch

Technical specifications for the Managed Layer 2 Industrial grade, 61850-3 compliant Ethernet switch is given below:

- a. The switch shall be of industrial grade type designed for continuous operation.

- b. Switch shall have minimum 16 ports – RJ45 (10/100Mbps)
 - o No. of CU Ports : 8 CU Ports (RTU)
- c. Switch shall be preferably Din rail mountable with Power Socket and Ports at rear side
- d. LED indicators for link establishment and data transfer for each port
- e. Should support remote configuration
- f. It should own separate maintenance/console port
- g. Latency shall not be more than 10 μ s.
- h. Should support SNMP Server v1.0/v2.0/v3.0
- i. Should be KEMA Certified for IEC61850 Communication profile.
- j. All the cards/modules of the Switch must have conformal coating for protection against harsh environments.
- k. Switch shall support IEEE802 series for VLAN, RSTP, MSTP and Suitable for ring configuration etc.
- l. Switch shall be IEC 61850-3 compliant for EMI/EMC, Temperature, Humidity and operating conditions for Electrical Substations environment.
- m. Switch shall also be IEEE 1613 Environmental Standard for Electric Power Substations environment.
- n. Switch shall have design for minimum Heat generation and high MTBF (minimum time between failure)
- o. Switch shall Support Simple plug and play operation - automatic learning, negotiation, and crossover detection
- p. Switch shall Support Quality of Service (802.1p) for real-time traffic
- q. Switch shall Support SNTP time synchronization packet (client and server) for synchronization of networks
- r. Switch shall Support Industrial automation features (e.g. Modbus, Ethernet/IP and IEC61850 protocols for transparent data transmission)
- s. Switch shall be suitable for setting up PRP/HSR communication network.
- t. Switch shall Support Management Tools like:
 - Web-based, Telnet & Command Line Interface (CLI) for quickly configuring major managed functions
 - SNMP v1/v2c/v3 for different levels of network management
 - Remote Monitoring (RMON)
 - Rich set of diagnostics with logging and alarms
 - Bidder shall supply Console Cable along with each switch

1.43.1 LAYER 2 features

- a. The Switch should support Layer 2 switch ports with Secure VTP or similar protocols to reduce administrative burden of configuring VLANs on multiple switches in turn eliminating the configuration errors & troubleshooting in secure manner.
- b. The Switch should support Rapid Spanning Tree Protocol & Multiple Spanning Tree Protocol.
- c. The Switch shall have IEEE compliance for 802.1Q VLAN, 802.1p, 802.1d STP, 802.3ad (Port aggregation), 802.1w RSTP, 802.1s MSTP, 802.3ad LACP, IEEE 802.1ab Link Layer Discovery Protocol.
- d. The switch should have support for Port mirroring and link aggregation.
- e. The Switch should be able to discover the neighboring device of the same vendor giving the details about the platform, IP Address, Link connected through etc, thus helping in troubleshooting connectivity problems or equivalent
- f. The Switch should support a mechanism to prevent edge devices not in the network administrator's control from becoming Spanning Tree Protocol root nodes

1.43.2 Management features

- a. Switch Latency period: 10 Microsecond or better
- b. Transmit Rate of the ports: 10/100 Mbit/sec
- c. The Switch should support SNMP v2, V3
- d. The Switch should support Configurable SNMP traps
- e. The Switch should support Logging to syslog with time stamp
- f. Java Run time version - Latest
- g. The Switch should support NTP, SNTP support.

1.43.3 Power supply

- a. 24/48 V DC redundant power supply module, with $\pm 20\%$ tolerance
- b. Separate MCB with appropriate rating shall be used to power up the Switch

1.43.4 Environmental

- a. The switches should have IEEE 802.3az Energy efficient Ethernet and ROHS compliance
- b. Switch should be capable of operating under normal room temperature without the requirement of Air conditioning.
- c. Conformal Coating: Mandatory
- d. Operating Temperature: -5° to +85°C.
- e.

IEC60068-2-1	-	Cold Temperature
IEC60068-2-2	-	Dry Heat
IEC60068-2-30	-	Humidity (Damp Heat, Cyclic)

- IEC60068-21-1 - Vibration
IEC60068-21-2 - Shock, IEC61850-3- Environmental
IEC61850-3 - EMI/EMC, Temperature, Humidity etc. Substation Environment

1.43.5 Product Conformity

Product Conformity	Purchaser Requirement
IEEE 802.3-10BaseT	Yes
IEEE 802.3u-100BaseTX	Yes
IEEE 802.3u-100BaseFX	Yes
IEEE 802.3ab-1000BaseT	Yes
IEEE 802.3ad-Link Aggregation	Yes
IEEE 802.3x-Flow Control	Yes
IEEE 802.1d-MAC Bridges	Yes
IEEE 802.1d-STP	Yes
IEEE 802.1p-class of service	Yes
IEEE 802.1Q-VLAN tagging	Yes
IEEE 802.1Q-2005 (formerly IEEE 802.1s) MSTP	Yes
IEEE 802.1w-RRST	Yes
IEEE 802.1x-port based Network Access Control	Yes

1.44 Multi-Function Meter (MFM)

Bidder to consider Multifunction meter for each 33 & 11 kV feeders, which shall be mounted on the CRP panel for 33 kV and 11 kV feeders. These meters shall be integrated to RTU on MODBUS. Separate MFM shall be considered for Bus PTs (Bus Voltages). In case these meters are required to put in daisy chain, no more than ten MFM shall be considered in each loop.

Sl. No.	Description	Functionality Expected	Bidder Response
1	Accuracy Class	0.2S/0.5S as per IEC62053:11, IEC62053:21, IEC62053-22, IEC62053-23, EC62053-31, IEC61010, IS13779, IS14697,	
2	Sampling rate	80 samples per cycle for true RMS measurement	

Sl. No.	Description	Functionality Expected	Bidder Response
3	Voltage Input	57.7 - 240 V AC (-30 to +20%)	
	Voltage Burden	< 0.15VA	
	PT Ratio	1.0 - 6500	
	Primary Value of PT	Shall be programmable	
	Range of Reading	1 - 999000 V	
4	Current Input	1 A / 5A selectable from the front display	
	CT Burden	< 0.1 VA per phase	
	CT range	0.1% to 200%	
	Current over range	5A CT = 15A RMS continuous, 250A for 1 Sec 1A CT = 3A RMS continuous, 50A for 1 Sec	
	Range of Reading	0-60000 Amp	
	Primary Value of CT	Shall be programmable	
7	Power Factor	0.5 (lag) to 1.0 (unity) and 1.0 (unity) to 0.5 (lead)	
8	Accuracy kW / kWh	0.5 S as per IEC62053:22	
9	Real time & average parameters	Required	
10	Four quadrant measurement	Required	
11	LED Load Bar Indication	Optional	
12	Self Diagnostic LED	Required	
13	Real time clock	Required	
14	Min./Max of parameters	Required	
15	THD	Required	
16	Individual Harmonics upto 30th	Required	
17	Real time waveform monitoring	Standard software to monitor real-time waveform	
18	RS485 communication	Min 1 port	
19	Isolation	Galvanic	

Sl. No.	Description	Functionality Expected	Bidder Response
20	Communication protocols	MODBUS RTU, ASCII, selectable at site	
21	User defined registers	Optional	
22	Energy pulse LED for calibration test	Required	
23	Relay output	Optional	
24	Aux. power supply	18-72 V DC	
25	Ambient operating temperature	-20 to 60 °C	
26	Mounting Panel cutout	96 x 96 mm	

1.45 Networking Accessories

1.45.1 Surge Protection Device (SPD)

With Serial RS485 and Ethernet port industry standard Surge Protection Device (SPD) shall be provided. For details refer E2-3B_Technical Requirement_RTU System for Primary Substations for 92 Nos.

1.45.2 I/O Box

All the structured CAT6 cabling on the device side shall be terminated on I/O boxes.

1.45.3 Ethernet Patch cords

All the terminations on the switches / devices shall be done using factory crimped, flexible Cat 6 E UTP Patch cords of suitable length.

1.46 RTU Panel

1.46.1 Panel and other Accessories

- All the panels shall be of IP54 class and industrial grade.
- Control panel shall be suitable for bottom cable entry.
- Interconnection between panels shall be by prefabricated cables.
- A manual Local/Remote selector switch shall be provided for each FRTU to disable all control outputs by breaking the power supply connection to the control outputs.
- When in the "Local" position, the Local/Remote switch shall allow testing of all the control outputs of RTU without activating the control outputs to field devices. A status input indication shall be provided for the Local/Remote switch to allow the SCADA system to monitor the position of the switch. RTU with inbuilt local remote selector switch also will be acceptable.

- f. The Contractor shall provide a latching relay to be used to simulate and test supervisory control from the Master station. The latching relay shall accept the control signals from the FRTU to open and close, and shall provide the correct indication response through a single point status input.
- g. The Bidder shall submit the GA drawing considering the maintenance and aesthetic requirements and submit the drawings along with bill of material for purchaser's review.
- h. The bidder shall guarantee the satisfactory functioning of the system hardware mounted in the panels even in the event of failure of air-conditioning.
- i. Proper size Cable trays shall be provided in the panel after reviewing the number of cables to be terminated in the panel.
- j. Panel shall be designed in such a way that it shall be suitable for Kiosk and Concrete structure Control Room application.
- k. Enough space (for easy termination, for easy viewing of cable tags) shall be provided between the terminal channels and cable trays.
- l. Terminals shall be distributed functionally in the panel.
- m. Panel door locks shall have the common key.
- n. Acrylic glass sheet shall be provided, wherever the power cables & terminations are exposed and prone to be fatal.
- o. Electrostatic strap shall be fitted with each panel.

1.46.2 Sheet Metal Work

The panel frame shall be fabricated using suitable mild steel structural sections or pressed and shaped cold rolled sheet steel of thickness not less than 2.5 mm.

Frames shall be enclosed by cold rolled sheet steel of thickness not less than 2 mm, smoothly finished, leveled and free from flaws. Stiffeners shall be provided wherever necessary. The Panels shall be provided with MS Base Channel .

All panel edges and door edges shall be reinforced against distortion by rolling, bidding or by the addition of welded reinforcement member.

Cut-Outs shall be true in shape and devoid of sharp edges.

The complete structure shall be rigid, self- supporting, free from vibration, twists and bends.

1.46.3 Constructional Features

At least 50% of the space inside each enclosure shall be unused (spare) space that shall be reserved for future use. RTU cabinet shall be indoor type, floor mounted, with preferred dimension 2315(H) x 800(W) x800(D)) and both sides opening with swing frame. Front glass door with 19" rack arrangement. The

Contractor shall provide required panels conforming to IEC 529 for housing the RTU modules/racks, relays etc. and other required hardware.

The panel shall be -

- a. Panel shall be of the metal enclosed indoor, floor mounted.
- b. Preferred make of panel shall be
 - o RTU – Rittal/Pyrotech/Siemens make
- c. Made up of the requisite vertical sections.
- d. of dust, moisture and vermin proof construction
- e. It shall have lifting i-bolts for hooks of good capacity and even distributed lifting. Test certificates shall be available for the lifting bolts.
- f. Suitable to provide a degree of protection of not less than IP 54 as per IS: 2147.
- g. It is the responsibility of the contractor to ensure that the equipment specified, and such unspecified complementary equipment required for completeness of the SAS design shall be properly accommodated in the panel, in such a way that the maintenance, identification, isolation of any component or circuit shall be easy. Equipment shall be mounted such that removal and replacement can be carried out individually without affecting the services of the adjacent devices. No price increase at a later date on this account shall be allowed.
- h. Of self-cooled design with adequate louvers on sides. The louvers shall have screens and filters on inner side of panel. The screens shall be of fine wire mesh made of brass or GI wire.
- i. Shall have maintenance access to the hardware and wiring through lockable full height doors.
- j. Shall have the provisions for bottom cable entry.
- k. The safety ground shall be isolated from the signal ground and shall be connected to the ground network each ground shall be a copper bus bar. The grounding of the panels to the owner's grounding network shall be done by the contractor.
- l. All panels shall be supplied with 230 V AC, 50 Hz, single-phase switch and socket arrangement for maintenance.
- m. RTU shall be provided with internal maintenance lamps (LED) and space heaters and gaskets.
- n. All panels shall be indoor, dust-proof with rodent protection, and meet IP54 class of protection for indoor application.
- o. There shall be no sharp corners or edges. All edges shall be rounded to prevent injury.

- p. Document Holder shall be provided inside the cabinet to keep test report, drawing, maintenance register etc.
- q. Provided with labels on the front and rear indicating the panel designation.
- r. Proper provision must be provided for the entry of FO cables and Ethernet cables at the bottom. AC & DC incoming cable entry provision should also be there.
- s. Provided with pocket on rear door for keeping A4 size copy of panel drawings.
- t. Provided with 4 nos. of lifting hooks.
- u. Provided with neoprene gaskets all-round the perimeter of covers, gland plates, removable covers and doors.
- v. 150 sq.mm copper earth bar must be provided for equipment earthing.
- w. All sheet steel work shall be degreased, pickled, phosphate and then applied with two coats of zinc chromate primer and two coats of finishing synthetic enamel paint, both inside and outside. The paint shade shall be Siemens Grey (RAL 7032). The final finished thickness of paint film on steel shall not be less than 100 microns and shall not be more than 150 microns.
- x. For every distribution of AC and DC circuits MCB's must be provided. These MCB's must be rated according to the load on the distributed circuit.
- y. Each RTU/Gateway, Switch panels shall be provided with 20% spare terminals.
- z. If I/O interface boards are used for field input connection proper isolation facility shall be provided. Preferably disconnecting type of terminal blocks shall be used for all inputs.
- aa. Interconnection between panels shall be by prefabricated cables.
- bb. Terminal blocks shall be having provision for isolation, with full-depth insulating barriers made from moulded self-extinguishing material. Terminal blocks shall be appropriately sized and rated for the electrical capacity of the circuit and wire used. No more than two wires shall be connected to any terminal. Required number of TBs shall be provided for common shield termination for each cable. 10% spare terminal block shall be provided in the panel.
- cc. All materials used in the enclosures including cable insulation or sheathing, wire troughs, terminal blocks, and enclosure trim shall be made up of flame-retardant material and shall not produce toxic gasses under fire conditions
- dd. Proper lighting arrangement shall be made on both sides of the panel if both sides of the panels are used.

- ee. Space heater with thermostat shall be provided in the panel to maintain the required temperature.
- ff. Disconnecting type terminal blocks shall be used for CT, PT and for all Digital Outputs.
- gg. Enough space (for easy termination, for easy viewing of cable tags) shall be provided between the terminal channels and cable trays.
- hh. Terminals shall be distributed functionally in the panel.
- ii. The panel shall also have a document pocket.
- jj. Horizontal and vertical Grounding bus shall be provided in the panel. Green coloured wires shall be used for grounding purpose. Cable gland plate fitted on the bottom of the panel shall be connected to earthing of the Panel/Station through a flexible braided copper conductor rigidly.

1.46.4 Wiring /Cable Requirements

The RTU panels shall gather all signals from and to the devices located in Control & Relay panels in the substation control room. Pre-wired and prefabricated cabling may be used. All wires that carry low-level signals shall be adequately protected and separated as far as possible from power wiring. All wires shall be identified either by using ferrules or by colour coding. In addition, cables shall be provided with cable numbers at both ends, attached to the cable itself at the floor plate where it enters the cubicles. The cable distance shall be site surveyed by the bidder. The distance between RTU panels and Control & Relay panels in the substation control room is approximately 30 mtrs. These cable lengths mentioned are for indicative purpose only. The bidders are required to quote as per their site survey

The external Cabling between the RTU panels shall use shielded cables. The external cables (except communication cables) shall have the following characteristics:

- a. All cables shall have stranded copper conductor
- b. Minimum core cross-section of (3/20) 2.5 mm² for Control outputs and 0.5 mm² for Status inputs
- c. Minimum core cross-section of (3/20) 2.5 mm² for PT cables and for CT cables.
- d. Rated voltage Vo/V of 0.6 / 1.1kV
- e. External sheathing of cable shall have oxygen index not less than 29 & temperature index not less than 250. Cable sheath shall meet fire resistance test as per IS 1554 Part- I.
- f. Shielding, longitudinally laid with overlap.
- g. Dielectric withstand 2.5 kV at 50 Hz for 5 minutes
- h. External marking with manufacture's name, type, core quantity, cross-section, and year of manufacture.

- i. The Communication cable shall be of shielded, twisted pairs and of 0.22sq mm² size with dielectric withstand of 1 kV at 50 Hz for 1 minute.

RTU cabinet shall be wired with all the DC distribution wiring and AC wiring for the Illumination and fans. Following sizes of wires shall be

Colour Codes

DC wiring	1.5 sq.mm	Red/Black
AC wiring	1.5 sq.mm	Red/ Black

Engraved identification ferrules marked to correspond with the wiring diagram shall be fitted at both ends of each wire. These ferrules shall fit tightly on the wires and should not fall off when the wire is removed. The wires should be terminated on terminal blocks using soldering crimping type of tinned copper lugs. Insulated sleeves shall be neatly punched and cleaned without affecting access to equipment mounted within the cabinet. Wiring troughs shall be provided for cable routing inside the cabinet. One piece molded, 650 V grade terminal blocks complete with insulated barriers, screws, identification strips shall be used. Terminals links shall be of Elmex or Connectwell make. Terminals for power connections shall be adequately rated for the circuit current and the rating of other terminal blocks for central indication etc. shall not be less than 15 amps. At least twenty percent spare terminal blocks shall be provided. All the terminal blocks should be provided with proper identification strips. Terminal blocks shall be provided with transparent acrylic covers.

All internal wiring shall be securely supported, neatly arranged, readily accessible and connected to equipment terminals and terminal blocks. Cable ways & troughs shall be used for this purpose.

Wire termination shall be made with solderless 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.

1.46.5 Labels

All equipment shall be provided with individual labels with equipment designation engraved. Also, the control cabinet shall be provided on the front with a label engraved with designation of the cabinet as furnished by PURCHASER. Labels shall be made up of non-rusting metal or 3 ply lamicaid. Labels shall have white letters on black or dark blue background. Sizes of labels and lettering are subject to PURCHASER's approval.

Manufacturer's label should be provided at the rear door, which should mention the project ref, substation, P.O ref, circuit details, drawing ref.

1.46.6 Earthing Terminals

Control cabinet shall be provided with two separate earthing terminals suitable to receive PURCHASER's earthing conductors of size specified.

Positive connection between all the frames of equipment mounted in the switchboard and earth bus bar shall be provided by using insulated copper wire/bars bus bars of cross section equal to that of the bus bar or equal to half the size of circuit load current carrying conductor, whichever is smaller.

All equipment shall be connected to the earth busbar using 1100V grade PVC insulated 2.5 sq.mm stranded tinned copper earthing conductor.

All hinged doors shall be positively connected to the earthing bus terminals, with the help of braided copper conductors of adequate size.

An electrostatic discharge arrangement shall be provided in each panel so as to discharge human body before he handles the equipment inside the panels

1.46.7 Terminal Blocks

Terminal blocks shall be having provision for disconnection (isolation), with full-depth insulating barriers made from mounded self-extinguishing material. Terminal blocks shall be appropriately sized and rated for the electrical capacity of the circuit and wire used. No more than two wires shall be connected to any terminal. Each analog input signal, digital status input and digital output signals shall require two terminals per point plus a common shield termination for each cable. All terminal blocks shall be suitably arranged for easy identification of its usages such as CT circuits, PT circuits, analog inputs, status inputs, control outputs, auxiliary power supply circuits, communication signals etc.

1.47 RTU Test

The contractor shall supply type tested RTU. The bidder shall submit RTU type test reports along with the bid for the same and model of RTU. The type test reports minimum shall include the tests indicated in Table 1 and 2. Type test reports as per other equivalent standards are also accepted provided, they meet or exceed minimum requirements specified in this specification. In case the RTU type test report do not meet specification requirements, the relevant type tests shall be performed without extra cost to TPCODL. The vendor should submit proof of RTU certificate (As conforming to IEC 61850, IEC 60870-5-104/101) BY KEMA.

Routine test to be performed in the factory and the field test to be performed in the site on the RTU panels are indicated in Table – 1.

Test No.	DESCRIPTION OF THE TEST	Type test	Routine test	Field test
1.0	Functional Tests for RTU			
1.1	Check for BOQ, Technical details, Construction & Wiring as per RTU drawings		√	√

1.2	Check for RTU database & configuration settings		√	√
1.3	Check the operation of all Analog inputs, Status input & Control output points of RTU		√	√
1.4	Check operation of all communication ports of RTU		√	√
1.5	Check for communication with multiple master stations using partitioned databases		√	√
1.6	Check for auto restoration of RTU on DC power recovery after its failure		√	√
1.7	Test for RTU self-diagnostic feature		√	√
1.8	Test for RTU time synchronization from Master and GPS		√	√
1.9	Test for RTU SOE feature		√	√
1.10	Test for down loading of RTU data base from master station		√	√
1.11	End to end test (between RTU & Master station) for all I/O points			√
1.12	RTU Analog accuracy test for Analog inputs		√	
1.13	Test for RTU operation with DC power supply voltage variation		√	
1.14	Test for RTU internal Clock stability		√	
1.15	Test for RTU Noise level measurement		√	
1.16	Test for IEC 60870-5 -104 & IEC 61850 protocol implemented and matching with protocol profile of existing RTU		√	
1.17	Test for Control Security and Safety for Control outputs		√	√
1.18	Other functional tests as per technical specification requirements		√	
1.19	Test for RTU as Data concentrator for IEC 60870-5-104 and MODBUS, IEC60870-5-103 protocol		√	√
1.20	Test for operation of redundant CPU and Power supply unit		√	√
1.21	Test for Modems		√	√
2.0	EMI/EMC Immunity Tests for RTU			
2.1	Surge Immunity Test as per IEC 60870-2-1	√		
2.2	Electrical Fast Transient Burst Test as per IEC-60870-2-1	√		
2.3	Damped Oscillatory Wave Test as per IEC 60870-2-1	√		

2.4	Electrostatic Discharge test as per IEC 60870-2-1	√		
2.5	Radiated Electromagnetic Field Test as per IEC 60870-2-1	√		
2.6	Damped Oscillatory magnetic Field Test as per IEC-60870-2-1	√		
2.7	Power Frequency magnetic Field Test as per IEC-60870-2-1	√		
3.0	Insulation Test for RTU			
3.1	Power frequency voltage withstand Test as per IEC 60870-2-1	√		
3.2	1.2/50 μs Impulse voltage withstand Test as per IEC 60870-2-1	√		
3.3	Insulation resistance test	√		
4.0	Environmental Test for RTU			
4.1	Dry heat test as per IEC60068-2-2	√		
4.2	Damp heat test as per IEC60068-2-3	√		

Table – 1: List of Tests on RTU

Chapter # 2

Control Cables

2.0 Technical Specification for Control Cables

2.1 SCOPE

This part of the specification covers the technical requirements of design, Engineering, manufacture, stage testing, inspection and testing before dispatch, packing, forwarding, delivery at site the PVC, armoured, copper control cables for installation in substations

The material offered shall have been successfully type tested during last five years on the date of bid opening. The front page of type test report showing the evidence of successful type test of the items asked for in this Specification shall be uploaded with the signature of bidder. The full text of the type test report is to be submitted along with the technical proposal.

The control cables shall conform in all respects to highest standards of engineering, design, workmanship in accordance to this specification and the latest revisions of relevant standards, mentioned below.

2.2 STANDARDS IEC / ISO Indian Standard Title

Except where modified by this specification, the control cables shall be designed, manufactured and tested in accordance with the latest editions of the following standards.

Sl. No.	Standard Code		Brief Description of the Codes
1	IEC 811	IS-18-10810:1982	Testing cables
2	IEC 502	IS - 1554:1988 (Part 1)	PVC Cables 1100V
3	IEC 227	IS - 5819:1970	Short circuit ratings for PVC cables
4	IEC 228	IS-8130:1984	Conductors for insulated cables
5	IEC 287		Calculation of the continuous current rating of cables.
6	IEC 540	IS - 5831: 1984	Test Methods for insulation and sheaths of electric cables and cords IEC 287
7		IS - 3975: 1979	Mild steel wires, strips and tapes for armouring of cables

The Bidder may propose alternative standards, provided it is demonstrated that they give a degree of quality and performance equivalent to or better than the referenced standards. Acceptability of any alternative standard is at the discretion of the TPCODL. The Bidder shall furnish a copy of the alternative standard proposed along with technical proposal. If the alternative standard is in a language other than English, an English translation shall be submitted with the standard.

In the case of conflict, the order of precedence shall be

- a. Indian Standards
- b. IEC

This list is not to be considered exhaustive and reference to a standard or recommendation in this Specification does not relieve the Bidder of the necessity of providing the goods complying with other relevant standards or recommendations.

2.3 Technical Details

2.3.1 1.1 kV POLYVINYL CHLORIDE (PVC) INSULATED CABLES All control cables to be used shall be armored PVC type. The outer sheath of control cable shall be Polyvinyl chloride (PVC) type ST-2 of IS 5831.

2.3.2 Rated Voltage and Temperature Control and Panel Wiring Cables (PVC Insulated)

The conductor shall be of round stranded plain copper wires complying with IS - 8130:1984/ IEC 228.

N.B. - Conductor screening not required in this case.

2.3.3 Insulation

The insulation shall be of Polyvinyl Chloride (PVC) compound. 'Heat Resisting' Type C for the Control and Panel Wiring cables. Both shall conform to the requirements of IS - 5831: 1984.

Type of Insulation	Normal Continuous Operation	Short Circuit Operation
General Purpose	70 ⁰ C	160 ⁰ C
Heat Resisting	85°C	160°C

The PVC insulation shall be applied by extrusion and the average thickness of insulation as specified in IS – 1554 (part 1): 1988.

The insulation shall be applied so that it fits closely on to the conductor and it shall be possible to remove it without damage to the conductor.

Insulation Screening not required.

Core Identification and Laying up of Cores.

In multi-core cables, the cores shall be laid up together with a suitable lay as recommended in IS - 1554 (Part 1): 1988. The layers shall have successive right- and left-hand lays with the outermost layer having a right hand lay.

2.3.4 Inner Sheath

The laid-up cables shall be covered with an inner sheath made of thermoplastic material (PVC) applied by extrusion. The thickness of the sheath shall conform to IEC 502/IS - 1554: 1988. Single core cables shall have no inner sheath.

The outer serving shall incorporate an effective anti-termite barrier and shall be capable of withstanding a 10 kV DC test voltage for five minutes after installation and annually thereafter.

Current ratings shall be calculated in accordance with IEC 287 "Calculation of the continuous current rating of cables with 100% load factor".

2.3.5 Conductor Sizes

The following shall be used for Control and Panel Wiring:

The no. of Cores & Sizes of the Control Cable with flexible Copper Wires shall be 4 Core, 7 Core, 10 Core, 12 Core and 19 Core, 24 Core etc. There shall be one single core copper cable of 16 sq. mm size for earth wire. All panel wiring shall be done by 0.5 mm² for digital inputs, 1.5 mm² digital outputs, 1.0 mm² for Analog Inputs, 2.5 mm² for CT, 4 mm² for PT, CVT, AC & DC Supply connection.

4P X 0.36 mm² armoured, pair shielded, Overall shielded multistrand serial communication cable for Multi-Function Meters and Other Condition monitoring devices.

Bidder shall consider the cable size, number of conductors as per the site requirement and as mentioned in the indicative BOM.

2.3.6 Cable Drum Length

The cable shall be supplied in 500 meter lengths or more but with prior approval for the owner.

2.3.7 Cable Identification

The manufacturer's and Owner's name or trade mark, the voltage grade, cable designation and year of manufacture shall be indented or embossed along the whole length of the cable. The indentation or embossing shall only do on the outer sheath. The alphanumerical character size shall be not less than 20% of the circumference of the cable and be legible.

2.3.8 Sampling of Cables

2.3.8.1 Lot

In any consignment the cables of the same size manufactured under essentially similar conditions of production shall be grouped together to constitute a lot.

2.3.8.2 Scale of Sampling

Samples shall be taken and tested from each lot to ascertain the conformity of the lot to specification.

2.3.8.3 Sampling Rates

The number of samples to be selected shall be as follows:

Number of Drums to be taken as samples	Number of Drums to be taken as samples
--	---

Up to 25	3
26 to 50	5
51 to 100	8
101 to 300	13
301 and above	20

The samples shall be taken at random. In order to achieve random selection, the procedure for selection detailed in IS - 4905: 1968 shall be followed.

2.3.9 Number of Tests and Criterion for Conformity

Suitable lengths of test samples shall be taken from each of the selected drums. These samples shall be subjected to each of the acceptance tests. A test sample shall be classed as defective if it fails any of the acceptance tests. If the number of defective samples is less than or equal to the corresponding number given in the lot shall be declared as conforming to the requirements of acceptance test.

2.3.10 TESTS ON 1.1 KV PVC INSULATED Armored Control Cable

2.3.10.1 Type Tests

Certification of type tests already completed by independent test laboratories shall be presented with the bid for each cable type. These tests shall be carried out in accordance with the requirements of IS -8130: 1984/IEC 502, IS - 5831:1984/IEC 540 and IEC 811 unless otherwise specified. Type testing of 1.1 kV cables shall include the following:

Test Requirement Reference Test Method as a Part of IS-10810/IEC 811

- | | |
|---|------------------------|
| (a) Tests on conductor Annealing test (copper) | IS-8130: 1984/IEC 502 |
| (b) Resistance test | IS-8130: 1984/IEC 502 |
| (c) Tests for thickness of insulation and sheath | IS-5831:1984/IEC 540 |
| (d) Physical tests of Insulation Tensile strength & elongation at break | IS-5831:1984/IEC 540 |
| Ageing in air oven | IS-5831:1984/IEC 540 |
| Hot test | IS-5831:1984/IEC 540 |
| Shrinkage test | IS-5831:1984/IEC 540 |
| Water absorption (Gravimetric) | IS-5831:1984/IEC 540 |
| (e) Physical tests for outer sheath | |
| (f) Tensile strength and elongation at break | IS-5831: 1984/IEC 540 |
| (g) Ageing in air oven | IS-5 831: 1984/IEC 540 |
| (h) Shrinkage test | IS-5831: 1984/IEC 540 |
| (i) Hot deformation | IS-5831: 1984/IEC 540 |

(j)	Loss of mass in air oven	IS-5831: 1984/IEC540
(k)	Heat shock	IS-5831: 1984/IEC540
(l)	Thermal stability	IS-5831: 1984/IEC540
		IS-5831: 1984
(m)	Insulation resistance test	IS-8130:1984/IEC502
(n)	Volume resistivity	As per IS / IEC
(o)	High voltage test	As per IS / IEC
(p)	Flammability test	As per IS / IEC

2.4 Acceptance Tests

The following shall constitute acceptance tests:

- Tensile test (Aluminium)
- Annealing test (copper)
- Wrapping test
- Conductor resistance test
- Test for thickness of insulation and sheath
- Hot set test for insulation*
- Tensile strength and elongation at break test for insulation and outer sheath High voltage test
- Insulation resistance (volume resistivity) test
- PVC insulation only

** Test to be completed on full drum of cable

2.5 Routine Tests

Routine tests shall be carried out on all the cable on a particular order. These tests shall be carried out in accordance with the requirements of IS - 8130: 1984/IEC 502 and IS - 5831:1984/IEC 540 unless otherwise specified.

The following shall constitute routine tests.

- Conductor resistance test
- High voltage test
- Test to be completed on full drum of cable

2.6 DETAILS OF TESTS

2.7 General

Unless otherwise stated, the tests shall be carried out in accordance with the appropriate part of IS - 10810/IEC 502: 1994 and the additional requirements as detailed in this specification.

2.8 Bending Test

The diameter of the test cylinder shall be $20 (d + D) \pm 5\%$ for single core cables and $15 (d + D) \pm 5\%$ for multicores, where D is the overall diameter of the completed cable in millimetres and d is the diameter of the conductor.

After completing the bending operations, the test samples shall be subjected to partial discharge measurements in accordance with the requirements of this specification.

2.9 Dielectric Power Factor Test

Tan δ as a Function of Voltage

For cables of rated voltage 1.1 kV and above the measured value of tan δ at up shall not exceed 0.004 and the increment of tan δ between 0.5 up and 2 up shall not be more than 0.002.

2.10 High Voltage Test

2.10.1 For Type/ Acceptance Test

The cable shall withstand, without breakdown, at ambient temperature, an ac voltage equal to $3U_0$, when applied to the sample between the conductor and screen/ armour (and between conductors in the case of unscreened cable). The voltage shall be gradually increased to the specified value and maintained for a period of 4 hours. If while testing, interruption occurs during the 4 hours period the test shall be prolonged by the same extent. If the interruption period exceeds 30 minutes the test shall be repeated.

2.10.2 Routine Test

For Routine Test Single core screened cables, shall withstand, without any failure, the test voltages given in this specification for a period of five minutes between the conductor and metallic screen.

Single core unscreened cables shall be immersed in water at room temperature for one hour and the test voltage then applied for 5 minutes between the conductor and water.

Multicore cables with individually screened cores, the test voltage shall be applied for 5 minutes between each conductor and the metallic screen or covering.

Multicore cables without individually screened cores, the test voltage shall be applied for 5 minutes in succession between each insulated conductor and all the other conductors and metallic coverings, if any. When a DC voltage is used, the applied voltage shall be 2.4 times the power frequency test voltage.

In all instances no breakdown of the insulation shall occur.

2.10.3 Flammability Test

The period for which the cable shall burn after the removal of the flame shall not exceed 60 seconds and the unaffected portion (uncharged) from the lower edge of the top clamp shall be at least 50mm.

2.11 Control / LV Wiring Accessories

2.11.1 Terminations

Control wire terminations 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 termination. 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 unlettered ferrule. Numbers 6 and 9 shall not be included for ferrules purposes except where underlined and identified as 6 and 9.

Control cable terminals shall be provided with adequate size crimp type lugs. The lugs shall be applied with the correct tool, which shall be regularly checked for correct calibration. Bi-metallic joints between the terminals and lugs shall be provided where necessary. Terminals shall be marked with the phase colour in a clear and permanent manner. A removable gland plate shall be provided by the contractor at every cable entry to mechanism boxes, cabinets and kiosks. The Contractor shall be responsible for drilling the cable gland plate to the required size.

2.12 General Particulars and Guarantees

2.12.1 Compliance with Specification

The control cables shall comply in all respects with the requirements of this specification. However, any departure from the provisions of the specification shall be disclosed at the time of bidding in the Deviation Schedule in this document.

2.13 Compliance with Regulations

All the equipment shall comply in all respects with the Indian Regulations and Acts in force.

The equipment and connections shall be designed and arranged to minimize the risk of fire and any damage which might be caused in the event of fire.

2.14 Non-Conforming Product

The Project Manager shall retain responsibility for decisions regarding acceptance, modification or rejection of non-conforming items.

2.15 Inspection and Testing

The equipment shall successfully pass all the type tests, acceptance tests and routine tests referred to in the section on Tests and those listed in the most recent edition of the standards given in this specification.

TPCODL the right to reject an item of equipment if the test results do not comply with the values specified or with the data given in the technical data schedule.

Type tests shall be carried out at an independent testing laboratory or be witnessed by a representative of such laboratory or some other representative acceptable to the Project Manager. Routine and acceptance tests shall be carried out by the Bidder at no extra charge at the manufacturer's works.

Type Test certificates shall be submitted with the bid for evaluation. The requirement for additional type tests will be at the discretion of the TPCODL.

All costs in connection with the testing, including any necessary re-testing, shall be borne by the Bidder, who shall provide the TPCODL with all the test facilities which the latter may require, free of charge.

2.16 Guarantee

The Bidder shall guarantee the following:

- a. Quality and strength of materials used;
- b. Satisfactory operation during the guarantee period of one year from the date of commissioning, or 18 months from the date of acceptance of the equipment by the Project Manager following delivery, whichever is the earlier.
- c. Performance figures as supplied by the Bidder in the schedule of guaranteed particulars.

2.17 Packing and Shipping

2.17.1 Packing

The cable shall be wound on strong drums or reels capable of withstanding all normal transportation and handling. Each length of cable shall be durably sealed before shipment to prevent ingress of moisture. The drums, reels or coils shall be lagged or covered with suitable material to provide physical protection for the cable during transit and during storage and handling operations. In the case of steel drums adequate precautions shall be taken to prevent damage being caused by direct contact between the cable sheath and the steel. These precautions shall be subject to the approval of the Project Manager.

If wooden drums are used, then the wood shall be treated to prevent deterioration from attack by termites and fungi.

Each drum or reel shall carry or be marked with the following information:

- a. Individual serial number
- b. Owner's name
- c. Destination
- d. Contract Number
- e. Manufacturer's Name
- f. Year of Manufacture
- g. Cable Size and Type
- h. Length of Conductor (meters)
- i. Net and Gross Mass of Conductor (kg)
- j. All necessary slinging and stacking instructions.
- k. Destination:
 - i. Contractor's name:
 - ii. Name and address of Contractor's agent in Orissa:
 - iii. Country of origin:

The direction of rolling as indicated by an arrow shall be marked on a flange.

2.17.2 Storage

The site selected for the storage of cable drums shall be well drained and preferably have a concrete/firm surface which will prevent the drums sinking into the ground or being subjected to excess water thus causing flange rot.

All drums shall be stood on battens, in the upright position, and in such a manner to allow enough space between them for adequate air circulation. During storage the drums shall be rotated 90° every three months. In no instances shall the drums be stored "flat" on their flanges or one on top of each other.

2.18 Hazardous substances

The Bidder shall submit safety data sheets in a form to be agreed for all hazardous substances used with the equipment. The Bidder shall give an assurance that there are no other substances classified as hazardous in the equipment supplied. The Bidder shall accept responsibility for the disposal of such hazardous substances, should any be found. The Bidder shall be responsible for any injuries resulting from hazardous substances due to noncompliance with these requirements.

2.19 Spare Parts and Special Tools

The Bidder shall provide prices for spare conductor, joints and termination equipment. The TPCODL may order all or any of the spare parts listed at the time of contract award and the spare parts so ordered shall be supplied as part of the definite works.

A spare parts catalogue with price list shall be provided for the various cables, joints and termination equipment and this shall form part of the drawings and literature to be supplied. Any spare apparatus, parts or tools shall be subject to the same specification, tests and conditions as similar material supplied under the Contract.

They shall be strictly interchangeable and suitable for use in place of the corresponding parts supplied with the equipment and must be suitably marked and numbered for identification. Spare parts shall be delivered suitably packed and treated for long periods in storage. Each pack shall be clearly and indelibly marked with its contents, including a designation number corresponding to the spare parts list in the installation and maintenance instructions.

Chapter # 3

Modem

1. General Technical Requirements:

1.1 GPRS MODEM Functions:

- 1.1.1 Modem shall support all 4G LTE, fallback to 3G and 2G, GPRS basic functionalities.
- 1.1.2 Modem must have local indication for signal strength, LAN connectivity, authentication completion and data handshaking.
- 1.1.3 Modem must have minimum 20 NAT and 5 port forwarding configuration.
- 1.1.4 Modem should have network connectivity watchdog function and it should connect automatically to ISP after signal strength resume.
- 1.1.5 Modem should have internal application watchdog facility.
- 1.1.6 Modem should have firewall facility to filter MAC/IP and port of protocol.
- 1.1.7 Data interface should be Max download 150Mbps and Max upload 50Mbps
- 1.1.8 802.11b/g/n 1T1R (max. 150Mbps throughput) Client or Access-Point, multiple SSID, WEP, WPA, WPA-PSK/WPA2-PSK
- 1.1.9 User should able to access modem webpage without hampering the modem-FRTU-master SCADA communication.
- 1.1.10 Modem should have feature to integrate min 2 Ethernet device.
- 1.1.11 Modem should support LTE/HSPA/HSDPA/UMTS/3G/EDGE/GPRS/GSM.
- 1.1.12 PPP with static and dynamic address negotiation & PAP, CHAP authentication.
- 1.1.13 Modem should support PPP, IPCP, PAP, CHAP, ARP, IP, ICMP, TCP, UDP, IPSEC, SNTP, TFTP network protocols.
- 1.1.14 Modem should support multiband connectivity with FDD 4G LTE & TDD 4G LTE. It should support Band 1,3,5,8 and Band 40. The offered cellular router should support and compatible to the data & radio interface of the network of public mobile service provider in Odisha
- 1.1.15 ICMP ping & Trace route support.
- 1.1.16 Modem should have remote firmware update facility.
- 1.1.17 Modem should have configuration archival and download feature.
- 1.1.18 Modem should have provision for adding SNTP server IP.
- 1.1.19 Modem should support telnet access. Telnet access should have diagnosis feature like pinging the connected device, netstat, trace route etc.
- 1.1.20 Modem should support remote start/stop and restart function using web browser and telnet.
- 1.1.21 Automatic re-establishment of communication in case of temporary failure of wireless link.
- 1.1.22 Modem should support web based monitoring from remote as well as local. User should able to see the diagnosis log and event on webpage from remote. Event logging with time stamp is required.
- 1.1.23 Modem should have alarm event reporting feature through SMS.
- 1.1.24 Modem should support remote SMS command feature like reboot or signal monitoring.
- 1.1.25 Industrial-grade hardware with -20 to +70 degrees Celsius.
- 1.1.26 Modem shall support feature of remote configuration as well as diagnosis.
- 1.1.27 Inbuilt security mechanisms to prevent unauthorized entry to the system. Modem should support all cyber security standard and upgradation of cyber security feature should be possible.

- 1.1.28 As the SCADA/DMS system will use public domain such GPRS/CDMA etc., therefore it mandatory to guard the data/ equipment from intrusion/damage/breach of security & shall have SSL/VPN based security.
- 1.1.29 Shall support SNMP.
- 1.1.30 Capability of time synchronization with GPS receiver and SCADA.
- 1.1.31 Modem should have DIN Rail Mounting arrangement.
- 1.1.32 Modem should have default configuration reset facility.
- 1.1.33 Modem shall have inbuilt DI/DO for rebooting RTU over SMS
- 1.1.34 Modem shall support SMS send as well as receive functionalities
- 1.1.35 On receipt of SMS modem shall disconnect the power supply of RTU for configured time and again restore power supply after it. This feature ensures remote rebooting of RTU over SMS
- 1.1.36 Modem shall support remote soft rebooting of modem over SMS

1.2 Communication Port:

- 1.2.1 Modem must have minimum one TCP/IP Ethernet port for communication with FRTU using IEC 60870-5-104/101 protocol.
- 1.2.2 Modem should have auto-negotiation feature in Ethernet port for cross and straight cable.
- 1.2.3 Modem should have minimum one number of serial ports or console port for configuration of modem.
- 1.2.4 Modem should have wi-fi hotspot connectivity feature with essential industrial and cyber security.
- 1.2.5 Modem should have one port for WAN connectivity.
- 1.2.6 LAN and WAN port shall have capability to support smooth communication up to 50 meter distance.

1.3 Communication Protocol:

- 1.3.1 Modem should have feature to pass through IEC 60870-5-104/101 communication protocol for SCADA master station.
- 1.3.2 Modem should support PPP, IPCP, PAP, CHAP, ARP, IP, ICMP, TCP, UDP, IPSEC, SNTP, TFTP network protocols.

1.4 Firmware upgradation

The modem should have firmware upgrade feature. Additional security feature can be upgraded through firmware upgradation. Modem should have feature to reset the default configuration by software or hardware. Firmware upgradation should be covered under 60 month warranty.

1.5 SIM card section:

- 1.5.1 Cellular router should have dual SIM provision. Dual SIM for network redundancy /backup. Dual SIM operation ensures that the cellular connection is always available. It will automatically disconnect the 1st SIM card's low/weak cellular connection and will reconnect to establish a stronger connection using the 2nd SIM card.

- 1.5.2 For placing the SIM card, a SIM card holder shall be provided on the motherboard and shall be accessible only by opening /sliding the cover, modem shall not be opened for replacing the SIM card with sealing provision.
- 1.5.3 Modem SIM card slot should be design with respect to support all service provider Indian GPRS SIM card size.
- 1.5.4 Modem SIM card slot should have sealing facility to avoid access to unauthorized person.
- 1.5.5 The SIM card supported shall be of 1.8V/3V interface.

1.6 Antenna:

- 1.6.1 Standard SMA female interface, 50 ohm lightning protection(optional)
- 1.6.2 Antenna with maximum Cable length should be considered with each supplied modem.

1.7 Configuration cable:

- 1.7.1 Required configuration cable should be considered with each supplied modem.
- 1.7.2 Ethernet straight cable should be considered with each supplied modem.

1.8 Power supply:

- 1.8.1 Offered GPRS modem should be capable to operate on 9V to 60 V DC.
- 1.8.2 DC power cord with connector should be provided with modem.

1.9 GPRS Section:

GPRS modem shall comply with the following

- 1.9.1 Modem should support LTE/HSPA/HSDPA/UMTS/3G/EDGE/GPRS/GSM.
- 1.9.2 Modem should support point to point communication.
- 1.9.3 Modem should support HSPA/UMTS/3G 2100/1900/850 or 2100/1900/900 Mhz network.
- 1.9.4 Modem should support GSM/GPRS/EDGE/GSM 850/900/1800/1900 Mhz network.
- 1.9.5 Download speed for HSPA/UMTS/3G 7.2 Mbps
- 1.9.6 Cable to connect the communication module of FRTU.

5. Accessories:

- 5.1 GPRS Modem.
- 5.2 Power cord and connectors.
- 5.3 Antenna.
- 5.4 C channel din rail mounting accessories.
- 5.5 User guide for configuration and maintenance

6. Training:

Bidder shall give 20 man-day's training on operation and configuration to TPWODL. Training will be at the time of Factory acceptance test (FAT) and site acceptance test at site.
Modem training course shall cover the following:

- 6.1 Modem operation including data flow.
- 6.2 Troubleshooting, identification and replacement of faulty Modules.
- 6.3 Preventive maintenance of the Modem
- 6.4 Use of Modem configuration and Maintenance tool
- 6.5 All functional and Diagnostic testing of Modem
- 6.6 Database modification and configuration of Modem

7. Documentation:

The bidder shall submit all the standard and customized Modem documents for review and approval which includes the following:

- 7.1 Modem Function design document
- 7.2 Modem Hardware description document & all the documents referred therein to meet all the clauses of the specification.
- 7.3 Modem Test equipment user documents.
- 7.4 Modem user guide
- 7.5 Modem Operation & Maintenance document
- 7.6 Modem Training documentation
- 7.7 Modem database document
- 7.8 Modem Test procedures
- 7.9 Data Requirement Sheet (DRS) of all items
- 7.10 Protocol documentation including implementation profile etc.
- 7.11 Modem installation and Layout, GA, BOQ, schematics and internal wiring drawings for each Modem site

8. Tests & Test Certificates:

Modem shall have been type tested as per latest IEC. The bidder shall submit Type test reports for 4G GPRS modem.

The modem's Shall have passed type tests carried out by government accredited labs and in accordance with IEC 255-4, 255-6, 801-2 and 801-3 to demonstrate that the FRTU's comply with the ratings stated in these standard. As a minimum, certificates for the following type tests shall be furnished:

- 8.1 Dielectric test
- 8.2 Impulse Voltage withstand test
- 8.3 High frequency disturbance test
- 8.4 Thermal requirement test
- 8.5 Mechanical requirement test
- 8.6 Limiting dynamic value test
- 8.7 Contact performance test
- 8.8 Electromagnetic radiation susceptibility test
- 8.9 Electrostatic discharge susceptibility test

The Modem shall pass manufacture's standard routine test in accordance with the reference standard. In addition to the tests described in the IEC standard, the routine test and test reports of the Modem's shall include the following:

- 8.10 Visual test to confirm that construction and sizing requirement have been met.
- 8.11 Rigorous testing of each input and output functions of the Modem's. This shall include the Fault detection and the disturbance data storage functions as well as the operation of the modem time and the date facilities.

- 8.12 Verification of the use of the Modem test equipment for maintenance and testing.
- 8.13 Verification that Modem software and firmware support modem sizing and expansion requirements.
- 8.14 Verification of successful communication (i.e. protocols) all the required data rates.
- 8.15 Testing of secure operation.

Verification of the ability to download parameter and configuration data from remote server as well as from local laptop.

TPWODL reserves right to ask, type test certificate for any component used.

9. **Factory inspection:**

- 9.1.1 Equipment shall be subject to inspection by a duly authorized representative of the Purchaser. Inspection may be made at any stage of manufacture at the option of the purchaser and if the equipment found unsatisfactory as to workmanship or material, the same is liable for rejection. Supplier shall grant free access to the place of manufacture to the purchaser's representative at all times when the work is in progress.
- 9.1.2 Supplier shall give prior inspection notice. **(15 days for domestic and 30 days for international)**
- 9.1.3 Factory inspection will be carried as per approved QAP.
- 9.1.4 Material shall be dispatched after Dispatch Clearance only.

10. **Inspection of material after receipt at store:**

Material after receipt at TPWODL Store / site will be inspected by special team designated by TPWODL team.

11. **Guarantee & Service:**

Supply of all equipment's and associated accessories shall be guaranteed for satisfactory performance for period of **60** months from the date of commissioning. In case of failure of equipment / part of equipment's during guarantee period it shall be replaced or repaired by supplier free of cost. Supplier should replace the faulty modem with operational modem during the replacement and repair duration. Supplier has to provide remote and on-site support to resolve the hardware and software related issue.

Chapter # 4

Earthing and Earth Pit

3.0 Earthing and Earth Pit

3.1 Earthing of Panels, Equipment, Control cables etc.

3.2 All panels shall be equipped with an earth bus securely fixed. Location of earth bus shall ensure no radiation interference from 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 copper with threaded holes at a gap of 50 mm with provision of bolts and nuts for connection with cable armours 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 Contractor. Provision shall be made for extending the earth bus bars to future adjoining panels on either side.

3.3 Provision shall be made on each bus bar of the end panels for connecting Substation earthing pit done by the bidder. Necessary terminal clamps and connectors for this purpose shall be included in the scope of supply of Bidder.

3.4 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 2.5sq. mm.

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

3.6 An electrostatic discharge arrangement shall be provided in each panel so as to discharge human body before he handles the equipment inside the panels.

The metal sheath and Armour should be efficiently bonded and earthed at all terminals to earth electrodes provided.

The cross-sectional area of the bond shall be such that the resistance of each bond connection shall not exceed the combined resistance of an equal length of the metal sheath and Armour of the cable.

Earthing connections shall be carried out with green wire and the earthing studs shall be identified as such by an earthing symbol.

3.7 Earth Pit

Construction of unit earth pit:

- a. A hole of 100mm to 125mm dia shall be augured /dug to a depth of about 2.8 meters.
- b. The earth electrode shall be placed into this hole.

- c. It will be penetrated the soil by gently driving on the top of the rod. Here natural soil is assumed to be available at the bottom of the electrode so that min. 150 mm of the electrode shall be inserted in the natural soil.
- d. Earth enhancement material (minimum approx. 30-35 kg) shall be filled into the augured/dug hole in slurry form and allowed to set. After the material gets set, the diameter of the composite structure (earth electrode + earth enhancement material) shall be of minimum 100mm dia covering entire length of the hole.
- e. Remaining portion of the hole shall be covered by backfill soil, which is taken out during auguring /digging.
- f. A copper strip of 300mmX25mmX6mm shall be exothermically welded to main earth electrode for taking the connection to the main equi-potential earth busbar in the equipment room and to other earth pits, if any.
- g. Exothermic weld material shall be tested as per provisions of IEEE 837 by NABL/ILAC member labs.
- h. The main earth pit shall be located as near to the main equi-potential earth busbar in the equipment room as possible.
- i. Earth Cabinet made of concrete shall properly cover and properly labelled to identify each Electronic Earth Pit.
- j. Tap water pipe is to be extended upto the Electronic earth pit to ensure watering during dry season.

3.8 Earth Enhancement material

Earth enhancement material is a superior conductive material that improves earthing effectiveness, especially in areas of poor conductivity (rocky ground, areas of moisture variation, sandy soils etc.). It improves conductivity of the earth electrode and ground contact area. It shall be tested and confirm to the requirements of IEC 62561-7 having following characteristics:

- a. shall have high conductivity, improves earth's absorbing power and humidity retention capability.
- b. shall be non-corrosive in nature having low water solubility but highly hygroscopic.
- c. shall have resistivity of less than 0.12 ohms -meter.
- d. shall be suitable for installation in dry form or in a slurry form.
- e. shall not depend on the continuous presence of water to maintain its conductivity.
- f. shall be permanent & maintenance free and in its "set form", maintains constant earth resistance with time.
- g. shall be thermally stable between -100 C to +600 C ambient temperatures.
- h. shall not dissolve, decompose or leach out with time.

- i. shall not require periodic charging treatment nor replacement and maintenance.
- j. shall be suitable for soils of different resistivity.
- k. shall not pollute the soil or local water table and meets environmentally friendly requirements for landfill.
- l. shall not be explosive.

3.9 Earth Electrode

The earth electrode shall be made of high tensile low carbon steel circular rods, molecularly bonded with copper on outer surface to meet the requirements of Underwriters Laboratories (UL) 467-2007 or latest or IEC 62561. Such copper bonded steel cored rod is preferred due to its overall combination of strength, corrosion resistance, low resistance path to earth and cost effectiveness.

The earth electrode shall be of minimum 17.0 mm diameter and minimum 3.0 mtrs. long.

Earth electrode can be visually inspected, checked for dimensions and thickness of copper coating using micron gauge. The supplier shall arrange for such inspection at the time of supply, if so desired.

End of Section - B

Section – C

SCHEDULES

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C1 - SCHEDULE OF QUANTITIES AND PRICES

SUPPLY:

Sr. No.	Description	Qty. Set / Nos.	Unit Price (Rs.)	Item Price (Rs.)

SERVICES:

Seal of the Company

Signature

Designation

Note: Please Refer Indicative Bill of Material for Schedule of Quantities and Prices attached in Excel Format with this Specification. However, bidder shall derive the detailed BOM based on the proposed solution in the same Excel format and submit along with the proposal.

C2- PROJECT TIME SCHEDULE

Seal of the Company

Signature

Designation

Note: The bidder shall indicate schedule of milestones and attach/furnish a detailed bar chart identifying Purchaser's inputs.

C3- SCHEDULE OF DRAWINGS & DOCUMENT SUBMISSION

As part of the proposal, the BIDDER shall furnish the schedule of Drawing/Document submission

Sr. No.	Title of Drawing/Document	Target Date of submission	For Information/Review/Approval	Remarks
1.0				
1.1				
1.2				
2.0				
2.1				
2.2				
3.0				
3.1				
3.2				
4.0				
4.1				
4.2				
5.0				
5.1				
5.2				

Seal of the Company

Signature

Designation

Note: The bidder shall list out all relevant Drawings / Documents as mentioned in Section-D.

C4- SCHEDULE OF MANDATORY SPARES

As part of the proposal, the BIDDER shall indicate below the list of recommended spares for Ten Years (10 years) of trouble free operation of the equipment/system offered.

Sr. No.	Equipment Tag No.	HSN Code	Description of Spare	Material of Construction	Part No.	Quantity recommended per unit of equipment	Unit Price	Total Price	Delivery period from date of LOI	Remarks

Seal of the Company

Signature

Designation

C5 - SCHEDULE OF SPECIAL ERECTION/MAINTENANCE TOOLS & TACKLES

As part of the proposal, the BIDDER shall indicate below, the list of erection/maintenance tools & tackles offered by him.

Sr. No.	Description of Spare	Quantity recommended per unit of equipment	Unit Price	Total Price	Delivery period from Date of LOI	Remarks

Seal of the Company

Signature

Designation

C6 - SCHEDULE OF PLACES OF MANUFACTURE, TESTS & INSPECTION

For major equipment / systems, the Bidder shall indicate the name of the Manufacturer / Subcontractor and place of test and inspection.

Item of Equipment	Manufacturer / Subcontractor	Place of Testing & Inspection

Seal of the Company

Signature

Designation

C7- SCHEDULE OF RECOMMENDED SPARES

As part of the proposal, the BIDDER shall indicate below the list of recommended spares for Ten Years (10 Years) of trouble free operation of the equipment/system offered by him.

Sr. No.	Equipment Tag no.	Description of Spare	Material of Construction	Part No.	HSN Code	Quantity recommended per unit of equipment	Unit Price	Total Price	Delivery period from date of LOI	Remarks

Seal of the Company

Signature

Designation

C8 – Manufacturer’s Authorization

(To be obtained from all OEMs)

Date: _____

Bid Reference No.: _____

To: _____

WHEREAS _____ who are official manufacturers of _____ having factories at _____ do hereby authorize _____ to submit a Bid in relation to the invitation for Bids indicated above, the purpose of which is to provide the following Goods, manufactured by us _____ and to subsequently negotiate and sign the Contract.

We hereby extend our full Guarantee and Warranty in accordance with relevant Clauses mentioned in the Bid document (**GCC, Section-A** of Technical Specification), with respect to the Goods offered by the above firm in reply to this invitation for Bids.

Name: _____

In the Capacity of: _____

Signed: _____

Duly Authorized to sign the Authorization for and behalf of _____

Date: _____

Note: The bidder shall submit duly filled Manufacturer’s Authorization letter from the respective OEMs for the Supply and Services rendered to meet the required functionalities mentioned in the RFP.

C9 – Undertaking for Presence in India

I hereby declare that <Name of the Bidder>, has Design/Engineering/Testing/Support and Service facility in India as on _____ (i.e., release date of Bid).

The address of the facilities is provided hereunder

Signature of Authorized Signatory :

Full Name :

Address :

Phone Number :

Email Id :

Note: Necessary proof of incorporation/registration shall be submitted along with the Bid.

End of Section-C

Section – D

Drawings & Documents

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1.0 Tender Purpose

1.1 Mandatory documents required along with the Bid

1.1.1 Duly signed copy of TENDER as an acceptance to all terms and conditions as mentioned in this tender.

1.1.2 Bidder and Sub-Vendors - Company Statistics

Details	Bidder Response
Bidder's Name	
Address	
Contact (s), Title (s), Telephone (s), E-mail id (s)	
Name of the Chairman/ MD/ CEO/ Partners	
Nature of Ownership	
Date of Incorporation of Company/Entity	
Headquarter Location	
Other Office Locations, Functions and Personnel Strength	
1) Number of Employees by Function 2) Implementation 3) Sales 4) Support 5) Quality Assurance	
Size of Team for the Proposed Solution	
Location of Support Centers for Proposed Solution	
Other Businesses	

Table # 1: Bidder & Sub-Vendors – Company Statistics

Similarly, Bidder to submit the above details of all sub-vendors.

1.1.3 Bidder should depict complete understanding of the as-is system of the Utility based on the information provided in the Bid Document. It should also require listing down all the deliverables that has been planned as a part of the overall project with timelines.

1.1.4 Submission of documents as mentioned in Pre-Qualification Requirement

1.1.5 Technical Literature / GTP / Type Test Reports etc.

1.1.6 Details of all databases proposed and its relationship with application. Data flow diagram with entity relationship shall be submitted for all applications. Bidder shall clearly mention the list of application which are required to build data models manually.

- 1.1.7 GTP to be furnished about computing, network and integration interface infrastructure.
- 1.1.8 Submit details of methodology followed by the bidder and its sub-vendors in successfully implementing similar projects.
- 1.1.9 Schedule of Deviations if any from specification strictly following the prescribed format.
- 1.1.10 Commercial specification details as per attached sheet.
- 1.1.11 Proper authorization letter to sign the tender on behalf of bidder shall accompany the bid.
- 1.1.12 Compliance to the approved vendor list.
- 1.1.13 List of major relevant experiences of the Principal, Bidder, Sub-Vendors and the Product respectively.
- 1.1.14 Technical support facilities including qualified man-power, testing tools & instruments and integration facilities available within India.
- 1.1.15 Technical data sheet of all equipment including Sub-vendors systems, product brochure, white papers and case studies.
- 1.1.16 System Architecture drawings.
- 1.1.17 Detailed Bill of Material, covering all aspects of proposed System Architecture and functionality required by Purchaser as per the RFP.
- 1.1.18 Compliance to data sheets covered in the specification. **(Refer Annexure E2 - Technical Requirement of SAS System for Conventional Sub-stations)**
- 1.1.19 Product life cycle document of all equipment of Bidder's own and of Sub-Vendors.
- 1.1.20 Quality Assurance Plan (QAP), Manufacturing Quality Plan (MQP), Field Quality Plan (FQP).
- 1.1.21 Testing facilities in India
- 1.1.22 Confirmation on lifetime, spares, manufacturing, onsite & Offsite technical support of the supplied equipment for the period of 10 years.
- 1.1.23 **Project Team Structure**

Furnish the detail of the team that would be deployed by bidder to execute the project. Please provide details of the team structure in the following format:

Name of Staff	Position Assigned	International or Domestic	Firm	Employment status with the firm (Full time/	Education (Degree, Year	Area of Expertise and no. of years of relevant	Task Assigned
A. Professional Staff							
B. Support Staff							

Table # 2: Proposed Project Team Structure

Similarly, bidder shall arrange the team details of the Sub-vendors, that would be deployed to execute the project

1.1.24 Team details (CVs)

Use the following format for key personnel who would be involved in the project. Please include details of team members proposed to implement the project, install or manage hardware, install and manage Substation Automation System, LAN/WAN etc., please ensure that the CV covers all the required field and details.

1.	Proposed Position							
2.	Name of Firm and Role							
3.	Name of Staff							
4.	Date of Birth						Nationality	
5.	Education							
	Year		Degree/Examination		Institute/Board			
6.	Membership of Professional Associations							
7.	Other Training							
8.	Countries of Work Experience							
9.	Languages							
	Language	Speaking		Reading		Writing		
10.	Employment Record							
	From	To	Employer		Positions Held			
11.	Detailed Tasks Assigned		12.	Work Undertaken that best illustrates capability to handle the tasks assigned:				
13.	Certification							
I, the undersigned, certify that to the best of my knowledge and belief, this CV correctly describes myself, my qualifications, and my experience. I understand that any willful misstatement described herein may lead to my disqualification or dismissal, if engaged.								
Signature of authorized representative of								
Date:								
Full name of authorized representative:								

Table # 3: Format for CV Submission

Similarly, Bidder to submit the key personnel details of the Sub-Vendors, who would be involved in the project. Please include details of team members proposed to implement the project, install or manage hardware, install and manage Substation Automation System, LAN/WAN etc.

2.0 After Award of Contract

Documentation shall be provided by the bidder for all equipment and functions offered as part of this procurement including Sub-vendors equipment/systems and functions. All documentation shall be in English. The documentation shall cover all systems required by Purchaser, including all its hardware, software, and interfaces and shall cover functionality, testing, installation, system startup, operations, and maintenance.

2.1 General Requirement

- a. The Bidder shall furnish the following drawings/documents during detailed engineering as per schedule (**Refer Section-A, Item 9.0**) from date of PO Placement Bidder to submit all datasheets, detailed GTP of the proposed BOM items during detailed engineering for the approval and finalization by Purchaser.
- b. System Architecture Drawing and design documentation. This drawing should show in detail of the following:
 - i. Network connections
 - ii. Protocol used
 - iii. Type of interconnecting cable
 - iv. All equipment, systems, RTU, network switches etc. which are part of the complete proposed solution.
- c. Panel GA and Complete wiring diagram
- d. Functional Design Specification document
- e. Step by Step test procedures for Factory Acceptance Test (FAT) and Site Acceptance Test (SAT)
- f. SCADA I/O List with protocol details along with addresses
- g. Interconnection Schedule (ICS) for Automation, detailed drawing indicating interconnections between various components.
- h. Hardware, Software and Application manuals for all the equipment supplied including that of Third parties.
- i. All Software Licenses (both own & third party), key for Hardware Locks
- j. All interoperability tables
- k. Software matrix indicating the details regarding versions, current license, expandability, tags/license limitations (if any) etc. along with the offer.
- l. Guaranteed technical parameters & Guaranteed availability and reliability
- m. Calculation for power supply dimensioning
- n. Bill of Material listing equipment designation, make, type ratings, etc. of all the equipment's supplied
- o. Logic Diagram (Hardware & Software)
- p. Submit the details of all databases proposed and its relationship with application. Data flow diagram with entity relationship shall be submitted for key applications. The detail shall clearly mention the list of application which are required to build data models manually.

- q. Operator's Manual
- r. Complete documentation of implemented protocols between various elements
- s. IP addressing chart for all the systems, RTU, network switches and other components / equipment which are connected to the network
- t. Other network diagram with all details pertaining to IP address and interfaces used to be provided as a controlled and restricted copy.
- u. Password management policy document to be provided with mechanism for storage and changing of password at specified interval clearly defined.
- v. Credentials created for all OEM systems for support to be provided as consolidated document stating clearly the SLA timelines agreed with each of the OEM.
- w. SLA signed document for system support and restoration in case of breakdown to be clearly document and provided as submission document.
- x. Bidder to provide recommendation on proposed network bandwidth required for smooth operation of the system in non-blocking mode. Diagnostic and performance evaluation software and hardware tools
- y. All tools and documents necessary to develop and maintain software such as compiler, CASE tool-kits and version control software shall be delivered along with RTU Software.
- z. Details of software (Operating systems, application software, engineering tools, communication systems management software, license details, I/O distribution protocol-wise etc.) for all offered systems (including RTU and configuration laptop computers etc.) and loadable in CD/DVD ROM.
- aa. Final as built drawings of all automation and communication system as final documents in AutoCAD & PDF format
- bb. Other documents as may be required / applicable during detailed engineering
- cc. All drawings and data shall be annotated in English.
- dd. Bidder shall furnish Four (4) hardcopies and 3 soft copies on reliable media of all drawings, manuals (Administration, Operation & Maintenance, Configuration, Troubleshooting and Installation), Technical catalogues, Test Certificates and Acceptance Test Reports.
- ee. Two copies of the internal test report, FAT and SAT documents with test protocol formats shall be submitted for approval at least four (4) weeks before Factory Acceptance Test. Two copies of SAT protocol shall be submitted for approval at least four (4) weeks before Site Acceptance Test.
- ff. Bidder shall also furnish Original plus one copy of all System Software (OS, Application and tools) along with delivery. Bidder shall submit two copies of all the configuration, application, display, database backup of all equipment on reliable secondary media.

2.2 Definitions

For the purposes of this project, the following definitions shall be used:

- a. **Documents or Documentation** – Textural and graphical information describing the offered equipment, systems, and other items peripheral for Substation Automation System, whether embodied in hardcopy or electronic form such as common word processor files. Documents

may also be referred to as manuals, guides, books, drawings, transmittals, and specifications. Documents are further divided into standard, OEM, and custom documents.

- b. **Standard documents** – Documents produced by the Bidder and used prior to the award of this contract that are applicable to all users of the equipment and software, including Purchaser. It is expected that the Bidder will use a formal revision control scheme to maintain its standard documents. Documents not maintained under such a scheme shall be considered custom documents.
- c. **OEM documents** – OEM (Original Equipment Manufacturer) documents are those standard documents produced by Vendor, Sub-vendors. Documents produced by Vendor, Sub-vendors for customized elements of the System shall be deemed custom documents.
- d. **Custom documents** – All documents not categorized as standard or OEM documents including the Bidder’s standard documents that are modified to meet Purchaser’s specific requirements.
- e. **Project Documents** – Project documents are those documents produced for the conduct of the project, but which do not directly describe the Sub-Station Automation System. Examples of project documents include meeting minutes, action item lists, test plans and procedures, and transmittal and document lists.

2.3 Project Planning Documentation

2.3.1 Documentation Plan

Bidder to note that after the order acceptance, the project kick off meeting will be arranged by the Purchaser, in which MDL will also be finalized, Bidder shall furnish the schedule for submission of documents for the documents mentioned in the MDL and accordingly arrange submit the documents for Purchaser’s Review and Approval.

It is expected that certain major documents, such as the detailed hardware and software design documentation, will consist of a series of submittals made over a period. The documentation plan shall address this by including a detailed list of all individual documentation submittals for the project.

Documents shall be submitted in a sequence as per the MDL, that allows Purchaser to have all the information necessary for reviewing or approving a document at the time of its submittal. The documentation plan shall be subject to Purchaser approval.

2.3.2 Project Progress Reports

A project progress report shall be prepared by the Bidder and sent to Purchaser every two weeks through the start of the warranty period. The report shall be submitted to Purchaser’s Project Manager no later than the 10th calendar day of each month. The report shall cover the project from the start of the contract through the last working day of the month.

The progress report shall include a general assessment of the progress on the project. This assessment shall reference the latest implementation schedule, which shall be included in the report. The schedule shall show the baseline and the current schedule, progress on individual tasks, and the forecasted completion dates for upcoming tasks and the entire project. Updated training and documentation plans shall be included.

The report shall include an explanation of existing and forecast schedule variances, the cause or source of the variance, alternatives considered, solutions adopted or recommended, and the outcome achieved or anticipated. In particular, the report shall note the needed delivery date of Purchaser furnished information. The Bidder shall be responsible for any schedule delays due to insufficient notification to Purchaser of the need for such information.

The report shall identify unresolved contract issues. This shall include a description of the item and the current due date, the consequences of any delay in resolution, and any recommendations pertinent to the decision process. The report shall also include the following items:

- a. A list of action items, including the following information:
 - i. Action item number
 - ii. Date the item was opened
 - iii. References to the originating transmittal and any reference documents
 - iv. Action item status (Open, Closed)
 - v. Resolution due Date
 - vi. Responsible Organization or Person
 - vii. A description of the action required
 - viii. The date of action completion (when each item is closed)
 - ix. References to transmittals or other documents recording the resolution.
- b. Correspondence logs, one for transmittals to Purchaser from the Bidder and one for transmittals to the Bidder from Purchaser. Each log shall have the following information for each transmittal:
 - i. The transmittal numbers
 - ii. The date of transmission (not the date written)
 - iii. The date received
 - iv. The subject of the transmittal
 - v. Identification of any action items addressed by the transmittal
 - vi. A list of any documents attached to the transmittal.

2.3.3 **Project Meetings, Agendas, and Minutes**

Project meetings shall be held to review project progress, to ensure correct interpretation of the contract, to review technical and commercial issues, and to maintain co-ordination between Purchaser and Bidder. Meetings shall be scheduled at appropriate times. Purchaser prefer to schedule meeting every month on average. The meetings shall be divided between Purchaser's and Bidder's offices. The Bidder's project manager shall prepare a meeting agenda in time for review by Purchaser before the meeting.

The Bidder shall prepare minutes of each meeting. Both Purchaser and the Bidder shall review and approve the minutes. The approved minutes shall be considered binding agreements, subject to concordance with the contract. Where the approved minutes conflict with the

contract, either the minutes shall be revised or a change order to the contract shall be generated. Where the minutes of a meeting conflict with the approved minutes of a previous meeting, the conflict shall be documented in the later minutes and those approved minutes shall have precedence.

2.3.4 **Project Correspondence**

All requests and transfers of information between the parties shall be made in writing and shall be documented with letters of transmittal. All correspondence from each party shall be dated (with the date of transmittal, not the date of writing) and uniquely numbered. Except for the meeting minutes, each letter or other project correspondence shall be limited to a single topic to simplify correspondence management. Correspondence transmitted via mail shall be considered as binding if a printed copy of the correspondence is delivered within four weeks of the mail transmission.

Correspondence may be exchanged by electronic mail. Such correspondence shall not be considered a substitute for formal correspondence, however. Agreements established through e-mail transmittals must be recorded as formal correspondence before they become binding. A printed copy of e-mail attached to a transmittal cover sheet shall be considered a formal transmittal.

All project management documentation, such as, correspondence, memos, meeting minutes, and monthly progress reports, shall be maintained. A mutually agreeable file numbering scheme shall be developed and used to minimize file storage and retrieval efforts.

2.3.5 **Detailed Implementation Schedule**

The Bidder shall submit for Purchaser's approval a detailed implementation schedule. This shall describe all the project activities of both the Bidder and Purchaser. As a minimum, this schedule shall include the following:

- a. Kickoff Meeting
- b. Preparation and finalization of MDL document
- c. Hardware procurement, integration, and testing
- d. Delivery dates for Purchaser furnished data, interface equipment, and software
- e. Subsystem integration and testing
- f. Interface testing
- g. Preparation of test plans and procedures
- h. Factory and Site tests
- i. Variance correction and retest

- j. System disassembly, delivery, and installation
- k. Final system and user documentation
- l. Training
- m. Submittal dates, review cycles, and acceptance dates for the hardware, software, and interface requirements documents.

The training and documentation schedules may be maintained outside the implementation schedule. However, the implementation schedule shall include all the dependencies of tasks contingent on documentation and training tasks.

The Bidder shall use a commercially available project management application (for example, Microsoft Project) to maintain the project schedule. This project management application shall be used to track the progress of the project from start through completion. Schedule monitoring shall be based on a comparison of completed tasks versus scheduled tasks and estimation of the required effort to complete the remaining tasks. The schedule presented to Purchaser shall be that used by the Bidder to manage their internal resources.

2.4 Document Format

Documents shall be delivered in two phases:

- a. Approval documents, submitted for Purchaser's review and approval
- b. Final documents

Purchaser prefers that documents be delivered in both hard and soft form. Softcopy shall be delivered on magnetic media. Final documents shall be delivered on hardcopy, and on softcopy on Secondary Media. Any user shall be able to access on-line documentation on Engineering Laptop including functional design documents, user guides, maintenance manuals, on-line help, and operating procedures via a simple procedure involving a one-click operation.

Documents shall be supplied in a format that can be edited by Purchaser. Handwritten texts are not acceptable. Purchaser's standard word processing software is Microsoft Office. The Bidder is encouraged to use this software for documents. If the Bidder uses other word processing or document production software, four copies of the software, suitable for installation on a personal computer using the Windows10 operating system or newer versions, shall be provided.

Drawings and diagrams may be supplied embedded in the document files or may be supplied as separate files. Purchaser's standard drawing software is AutoCAD. If the Bidder uses other

drawing software, four copies of the software, suitable for installation on a personal computer using the Windows10 operating system or newer versions, shall be provided.

Documents delivered as hardcopy shall be printed on both sides of A4 size paper and bound in three-ring binders. Divider pages with appropriately labeled tabs shall separate chapters. The spine of each volume shall be labeled with the document title and volume number so it may be easily identified when shelved.

Documents delivered on softcopy media shall be formatted for printing on A4 size paper.

Each document shall include a title or information page showing the document number, title, and revision record. The document number shall be a unique number assigned in accordance with the Bidder's standard practice. The title page shall include a space into which Purchaser may enter a document number assigned from Purchaser's document management system. The revision record shall describe each new version of the document since its original production. The revision record shall include:

- i. The date of the change
- ii. A brief description of the change
- iii. An indication that the change has been reviewed and approved in accordance with the Bidder's quality assurance procedure
- iv. The version or release of the hardware or software to which the document applies.

Each document shall include a table of contents. If a document is divided into several physical volumes, each volume shall contain the complete table of contents of the whole document. Furthermore, each document shall have a cross-reference table, listing all topics of significance covered by the document, and giving the page or section references of all pages or sections with discussions of the topic.

Documents that describe generic or typical Substation Automation elements will not be acceptable to Purchaser unless the specific material applicable to this project can be readily identified and material not applicable to this project can be similarly identified. Custom documents shall not contain any material that is not pertinent to this project.

Where the phrase "on-line documentation" is used in these Specifications, it shall be interpreted to mean the ability to view the document from any workstation. The Bidder shall provide all software necessary to provide this capability. For non-OEM documentation (documentation produced by the Bidder), the Bidder shall also provide the capability to edit and annotate the document.

2.5 Document Review and Approval

All standard and OEM documents provided pursuant to this contract shall be subject to review by Purchaser. Custom documents provided pursuant to this contract shall be subject to approval by Purchaser.

2.5.1 Document Review

Purchaser's review of documents shall be limited to determining that:

- a. The documents have been produced in accordance with the documentation standards of the Bidder or Sub-vendors
- b. All hardware and software are in full conformance with the contract
- c. The documents clearly and accurately describe the features and options of the hardware and software that pertain to the Substation Automation System and other applications
- d. The documents are written in English, and hard copies are printed legibly, and well bound.

Purchaser will review documents as per the schedule mentioned in the MDL. If Purchaser does not transmit comments on the documents within the review period, the Bidder shall discuss with the Purchaser.

If Purchaser transmits comments on any documents, the Bidder shall respond to the comments within seven working days or as per the MDL after receipt of the comments. If the comments address OEM documents, the Bidder shall act as an advocate of Purchaser to initiate and facilitate resolution of the comments with the Sub-vendor.

2.5.2 Document Approval

All custom documents shall be subject to a formal approval process. The review for approval performed by Purchaser will be similar to that for document review process but will more closely examine the functionality and design aspects of the hardware or software. Clarity and completeness of the presentation of the material within the documents will be a key element of the review for approval.

The approval process shall proceed as follows:

- a. The Bidder shall transmit documents subject to the approval process to Purchaser as per MDL. This MDL time may be adjusted by mutual agreement to accommodate the other activities of Purchaser and the Bidder. Requests by either party to change the time shall be made within two working days of receipt of the documents by Purchaser.
- b. Purchaser shall return comments to the Bidder within the agreed time. The transmittal cover for the comments shall clearly indicate that the document is either:

Approved

- If approved, the Bidder may proceed with the work covered by the document. No further approval action is required.

Approved with Comments

- If approved with comments, the Bidder may proceed with the work covered by the document and the comments.

Not Approved

- If not approved, the Bidder may proceed with the work covered by the document and the comments only at their risk. No schedule or cost relief will be granted for any work undertaken prior to approval of the appropriate documents.

- c. If desired by any party, the comments may be discussed to clarify Purchaser's intent.
- d. The Bidder shall then revise and resubmit the documents within five working days after receipt of the comments from Purchaser. This time may be adjusted by mutual agreement to accommodate the other activities of Purchaser and the Bidder. Requests by either party to change the time shall be made within two working days of receipt of the comments by the Bidder.

All changes made to documents to reflect approval comments shall be clearly highlighted and the revision record shall be updated to reflect the changes. Purchaser prefers the use of the change-tracking feature of the word processor used to produce the documents.

- e. The review and comment process shall be repeated until the document is accepted. After the document is accepted, Bidder shall deliver the required number of final copies free of highlighting due to tracking of changes.

All changes made to documents to reflect approval comments shall be clearly highlighted and the revision record shall be updated to reflect the changes. Purchaser prefers the use of the change-tracking feature of the word processor used to produce the documents.

2.5.3 Scope of Reviews and Approvals

The acceptance or approval of any documents by Purchaser shall not relieve the Bidder of the responsibility to meet all the requirements of the contract or of the responsibility for the correction of the documents. The Bidder shall have no claim for additional costs or extension of time on account of delays due to revisions of the documents that may be necessary for ensuring compliance with the contract.

All deliverable documentation shall be revised by the Bidder to reflect the delivered System. Any modifications to the offered/installed system resulting from the factory and site acceptance tests shall be incorporated in this documentation. All previously submitted documents that have been changed because of engineering changes, contract changes, or errors or omissions shall be resubmitted for review and approval.

2.6 Deliverable Documentation

Two soft copy and three hard copies shall be provided for review and approval. Two soft copy and five hard copies shall be provided for all the final documentation for each site.

Document	Delivery Date
Basic hardware documents	
i. List of deliverables, configuration diagram ii. Network configuration, interconnection lists	As per MDL
Equipment manuals	With each hardware delivery
Hardware maintenance manual	With each hardware delivery
Software list of deliverables	As per MDL
Software development standards	As per MDL
Database definition	i. For standard software – As per MDL ii. For other software – with the software functional description
Interface Requirements Document	With the software functional description
Software functional description	As per the project schedule
Installation images and source code	With the System delivery
Detailed design document	As per the project schedule
System maintenance manual	With the System delivery

2.7 Document Standards

The Bidder shall provide a document defining the standards used to create and maintain all documentation supplied by the Bidder. The standards shall define:

- a. The word processing or document production software used to create the documents
- b. Templates for each document type
- c. Definitions of the contents for each document type
- d. Drawing standards to be followed
- e. The approval process to be followed for document releases.

2.8 Hardware Documentation

The following documentation shall be provided for all hardware provided pursuant to this contract:

- a. List of deliverable hardware
- b. Equipment configuration diagram
- c. Network configuration diagram
- d. Interconnection list
- e. Site installation drawings and procedures.

The other hardware documentation to be supplied shall be commensurate with the hardware maintenance philosophy to be employed by Purchaser.

Equipment manuals shall be provided for all hardware to be maintained by the Bidder or a third-party maintenance Bidder. Equipment manuals and hardware maintenance manuals shall be provided for all hardware to be maintained by Purchaser.

2.8.1 List of Deliverable Hardware

The list shall itemize each hardware item and include equipment configuration information. The configuration information shall be enough so that Purchaser can procure an identical item from the manufacturer. The list shall also include network names and addresses (or these shall be included in the network configuration diagram) and shall include a space for Purchaser to enter equipment identification for their own purpose.

2.8.2 Equipment Configuration Diagram

The equipment configuration diagram shall depict the logical interconnection of all the Bidder-supplied equipment and its connection to Purchaser supplied equipment. The configuration diagram shall use the same terminology as the list of deliverable hardware so that the correspondence between the two can be readily determined.

2.8.3 Network Configuration Diagram

This document shall show the design of the local and wide area networks supplied by the Bidder as well as the communications network supplied by Purchaser. Both logical and physical depictions shall be provided for the network supplied by the Bidder. Only a logical depiction is required for the network supplied by Purchaser.

2.8.4 Interconnection List

The physical interconnections among the components, other than those shown on the network configuration diagram, shall be depicted. Each cable shall be identified, along with its terminations.

2.8.5 Site Installation Drawings and Procedures

The site drawings shall depict the physical arrangement of the components. References to the appropriate equipment manuals are acceptable. The drawings and procedures shall include:

- a. Equipment physical drawings showing dimensions, cabinet internal arrangements, and the size and weight of each enclosure
- b. Unpacking, moving, handling, and other installation details
- c. The location of external connections including types and sizes of connectors
- d. Input power and grounding requirements
- e. Environmental requirements

2.8.6 Equipment Manuals

Equipment manuals shall contain the following:

- a. A description of the function of the equipment
- b. Installation, setup, and operating instructions
- c. A block diagram showing the logical and physical interconnections among the major components
- d. Expansion and upgrade capabilities and instructions

- e. Preventative maintenance instructions
- f. Detailed functional, logical, electrical, and mechanical characteristics of all interfaces to the device, including protocol descriptions
- g. Troubleshooting and repair guides including a description and instructions for the diagnostics furnished.

2.8.7 **Hardware Maintenance Manuals**

The hardware maintenance manual shall describe the preventive maintenance and restorative procedures required to maintain the equipment in good operating condition. The information in the manuals shall include:

- a. Operating details – This information shall include a detailed description of how the equipment operates and a block diagram illustrating each major assembly in the equipment. Descriptions of external data transfers with other equipment, including data patterns, security check-codes, and transfer sequences shall be included. The operational sequence of major assemblies within the equipment shall be described and illustrated by functional block diagrams and timing diagrams. Detailed logic diagrams shall also be provided as necessary for troubleshooting analysis and field repair actions.
- b. Preventive maintenance instructions – These instructions shall include all applicable visual examinations, hardware testing and diagnostic routines, and the adjustments necessary for periodic preventive maintenance of the equipment. Instructions on how to load and use any test and diagnostic program and any special or standard test equipment shall be an integral part of these procedures.
- c. Corrective maintenance instructions – These instructions shall include procedures for locating malfunctions down to the field-replaceable module level. These guides shall include adequate details for quickly and efficiently locating the source of an equipment malfunction. The instructions shall also include explanations for the adjustment or replacement of all items, including printed circuit cards. Schematic diagrams of electrical, mechanical, and electronic circuits, parts-location illustrations, photographs, cable routing diagrams, and sectional views giving details of mechanical assemblies shall be provided as necessary to replace faulty equipment. For mechanical items requiring field repair, information on tolerances, clearances, wear limits, and maximum bolt-down torque shall be supplied. Information on the loading and use of special off-line diagnostic programs, tools, and test equipment, as well as any cautions or warnings that must be observed to protect personnel and equipment shall be included.
- d. Parts information – This information shall include the identification of each replaceable or field- repairable module. All other parts shall also be identified. The identification shall be of a

level of detail enough for procuring any repairable or replaceable part. Cross-references between the Bidder's part numbers and the manufacturer's part numbers shall be provided.

- 2.8.8 Bidder shall submit equipment warranty details of all the supplied system/equipment with detailed inventory list with make, model, Serial number, Software versions.

2.9 Software Documentation

The following documents shall be provided for all software:

- a. List of Deliverable Software
- b. Software development standards

The Bidder or Sub-vendors shall provide the following documents for all software that has been produced for the offered solution. This shall include all the required OS and application software for the systems mentioned in the specification:

- a. Database definition and data flow, along with an explanation of stored procedures
- b. Interface Requirements Document
- c. Software functional description
- d. Installation images and source code
- e. Source code version control and revision control documentation.
- f. Software release / Patch details as consolidated document to be submitted by Bidder.
- g. Recommended update frequency of all the software should be submitted as consolidated document by bidder.

The following documents shall be produced for all software produced specifically for this contract:

- a. Software Requirements Matrix
- b. Detailed design documents

2.9.1 List of Deliverable Software

The list shall itemize each software item and include version and license information. The distribution media for each software item shall be identified. The list shall also indicate for each item whether source code is supplied.

2.9.2 Software Development Standards

The Bidder shall document the development standards used to develop the Substation Automation System and other systems software. Purchaser reserves the right to reject software that does not conform to the development standards. The standards shall define:

- a. Program design disciplines
- b. Cyber Security measures
- c. Resources under which the program must operate
- d. Basic services
- e. Interface definitions
- f. Linkage conventions
- g. Input and output specifications
- h. Database naming and access conventions
- i. Storage rules
- j. Quality assurance procedures
- k. Configuration design review methods
- l. Software configuration control schemes.

2.9.3 Database Definition

The database definition shall identify the characteristics of all systems databases. It shall include, but shall not be limited to, the following:

- a. The name or identification of the database
- b. A description of the intended use of the database. If the database is specific to a single application, the application shall be identified
- c. A description of the organization of the database (the database schema or model)
- d. A description of each field of each data item
- e. Instructions for generating and populating the database
- f. Details of programming interfaces. This shall encompass access methods, address schemes, and read, write, and modify actions
- g. Initialization description – How or by what software is the data initialized & to what value(s)
- h. Details of maintenance actions.

Purchaser encourages the use of "self-documenting" database technology, where the database definition is developed and stored with the data. The resulting documentation should be printable.

2.9.4 **Interface Requirements Document**

The Interface Requirements Document shall describe in detail the interfaces between the offered systems and Purchaser provided/existing systems and networks. The Interface Requirements Document will be used by both the Bidder and Purchaser as the definition of the interface between the Substation Automation System, SCADA/ADMS and all other systems, so that each system can be designed or modified to meet its requirements. Purchaser will provide all required information to the Bidder so that it can prepare the document accordingly.

As a minimum, the Interface Requirements Document shall cover the following aspects:

- a. Description of the hardware interface
- b. Description of the communication protocols and the options and parameters selected
- c. Data exchange requirements including timing, priority, volume, and security requirements. A specific list of data to be exchanged during factory and site testing shall also be included.
- d. Description of the performance requirements
- e. Exception (for example, error) processing
- f. Failover/Backup processing
- g. Alarm conditions
- h. Archiving requirements.

2.9.5 **Software Functional Description**

The intent of the software functional description shall be to describe the functions to be performed by each software module from the standpoint of a user. (Software functional descriptions are also referred to as user guides.) The functional operation of the Substation Automation System and other systems shall be clearly described so that it can be understood without understanding the detailed operation of each software module.

Software functional descriptions shall also be used as the first step in the design of a custom (for example, new functionality). Thus, it shall have enough information for Purchaser to determine that the new functionality will meet the requirements of the contract.

The software functional description shall include the following minimum content:

- a. Functional description – A narrative description of each program. Where appropriate, solution algorithms shall be described
- b. Performance requirements – The execution periodicity, processing capacity, and tuning and execution parameters that control or limit the capabilities of the software
- c. Resource requirement – The expected minimum requirements for main memory, auxiliary memory, processor capacity, and other resources required by the software
- d. User interface – A description of the interface used to control the software, including all user inputs and program responses
- e. Software interface requirements – A description of the logic interfaces with other programs
- f. Data requirements – A description of all data and databases accessed by the software, including execution parameters
- g. Error messages – A concise description of all error messages and possible corrective actions
- h. Diagnostic messages – Where the software generates a record of its internal operations, the messages shall be described
- i. Maintenance and expansion procedures – A description of either maintenance procedures or expansion procedures that is relevant to maintenance of the program or expansion of the program.

It is Purchaser's strong preference that software functional descriptions are provided as on-line documentation.

2.9.6 Installation Images and Source Code

All software shall be delivered in three forms:

- a. As a fully operational system installed on auxiliary memory
- b. As distribution images suitable for installation on the system

The distribution images shall include all operating system, platform software, application software, and library of modifications incorporated into the delivered software. All standard software shall be supplied on the original installation media used by the Bidder to build the system. All customized software shall be supplied as part of the code management library along with the source code or other distribution image against which the code changes are to be applied.

It shall be possible for Purchaser to completely generate, build, install, and configure the entire System from the distribution images, source code, and software utilities provided with the System. To this end, "make files" or other compilation, generation, and installation tools, scripts, and directives shall be delivered.

For the purposes of this requirement, "software" shall specifically include the databases supplied with the System. That is, enough definition and content images shall be supplied such that the System databases can be created and installed on the Sub-Station Automation System and other offered systems.

2.9.7 **Software Requirements matrix**

The Bidder shall provide a list of all software requirements, cross-referenced to show where each requirement is discussed in the relevant software document.

The Software Requirements Matrix shall list each of the requirements for the Sub-Station Automation and other systems stated in this specification, in numerical order, referenced by chapter, section, and paragraph number. This list of specified requirements shall be supplemented by a list of all functions provided by the Bidder's software system that go beyond the specified requirements.

For each requirement on the list, a reference shall be given to the chapter and section where the requirement is described or covered in each of the following of the Bidder's documents:

- a. Item on the List of Software Deliverables
- b. Software Functional Description
- c. Operations Manual
- d. Factory Acceptance Tests
- e. Site Acceptance Tests.

2.9.8 **Detailed Design Document**

The detailed design documents are intended as a second level of detail to the software functional descriptions. In general, a detailed design document shall relate to a single software functional description. It is expected that, for customized software, the Bidder will first deliver a software functional description for approval by Purchaser. After approval, the Bidder will then produce a detailed design document for approval. Production of the software will proceed after approval of the detailed design document.

The detailed software design documentation shall include, but shall not be limited to, the precise design information needed for planning, analysis, and implementation of the software. It shall include a show the divisions of the software design entities; a dependency description specifying the dependent entities, their coupling, and required resources, an interface description providing details of external and internal interfaces not provided in the software functional description; and a detailed design description containing the internal details of each design entity.

The detailed software design documentation shall provide a detailed description of how the software will support the functions described in the software functional description. Detailed software design documentation shall include a diagram of the software indicating major modules and an overview of the operation of each module. It shall describe data structures and flow, and a diagram or description of the way the modules interfaces with other modules.

2.9.9 **System Maintenance Manual**

The System Maintenance Manual shall describe all user procedures necessary to build and maintain the Sub-station Automation System and other supplied systems. It shall provide information on optimizing system performance.

It shall include details on Configuration upgrades, firmware and patch upgrades

The System Maintenance Manual shall also include documentation of the distributed system software supporting the configuration control function, data integrity, startup, restart, and the network management subsystem.

The manual shall provide a list of the Internet Protocol (IP) addresses of all devices in a manner compatible with Purchaser's security standards and shall describe the procedures for upgrading or adding additional devices. The System Maintenance Manual shall provide detailed information on troubleshooting all processors of the Substation automation and other supplied systems. It shall describe the use of error logs, the meaning of all program-generated error or informational messages, and the recommended response to these messages. It shall explain what the user should do to save information after a processor failure and shall describe the procedures to gather this information to allow the user to communicate in an informed manner with maintenance personnel. It shall include a description of the procedures to restore normal operation after a failure of the offered systems.

2.10 **Operating Manual**

The Bidder shall submit, for review and approval, operating manuals for all Substation Automation functions. The operating instructions associated with all features shall be incorporated into these manuals. Context sensitivity shall be used to go directly to the appropriate place in the manual.

The manuals shall be organized for quick access to each detailed description of the user procedures that are used to interact with the Substation Automation functions. The manuals shall present in a clear and concise manner all information that a user needs to know to understand and operate satisfactorily. The manuals shall make abundant use of screen snapshots to illustrate the various procedures.

2.11 **System Administration Documentation**

The Bidder shall submit, for review and approval, all system administration manuals. The system administration instructions associated with all features shall be incorporated into these manuals. Context sensitivity shall be used to go directly to the appropriate place in the manual.

2.12 Database Editor's Manual

The Database Editor's Manual shall describe the procedures to define, build, edit, archive, and expand all the databases of the delivered systems. It shall contain information describing how a user may define and add new attributes to an existing database entity. It shall also describe how to restore any database to a previously saved version if the database had been corrupted.

2.13 Acceptance Test Procedures

Acceptance test procedures (FAT & SAT) designed to test the specified requirements shall be provided. The procedures will comprise step-by-step instructions to verify that:

- a. The system hardware and software are fully present and fully integrated, and its documentation is complete.
- b. All the functional and performance requirements of the contract are met.

The test procedures shall be organized in the order that they are to be performed. Tests that require collection of data under controlled conditions shall be carefully planned with data collection procedures scheduled, as needed, before the tests themselves.

The test procedure shall be prepared in the format of step-by-step guides. Test descriptions, initial conditions, functions to be tested, expected responses, and recording areas are contained in the acceptance test procedures. The steps to achieve these functions may be provided as references to the user manuals or maintenance manuals. An attempt shall be made to cover all normal and abnormal circumstances in the procedures. The goal is to be able to rigorously test the system by strictly following carefully pre-planned procedures with minimum reliance on unstructured testing.

End of Section-D

Section – E

Annexures

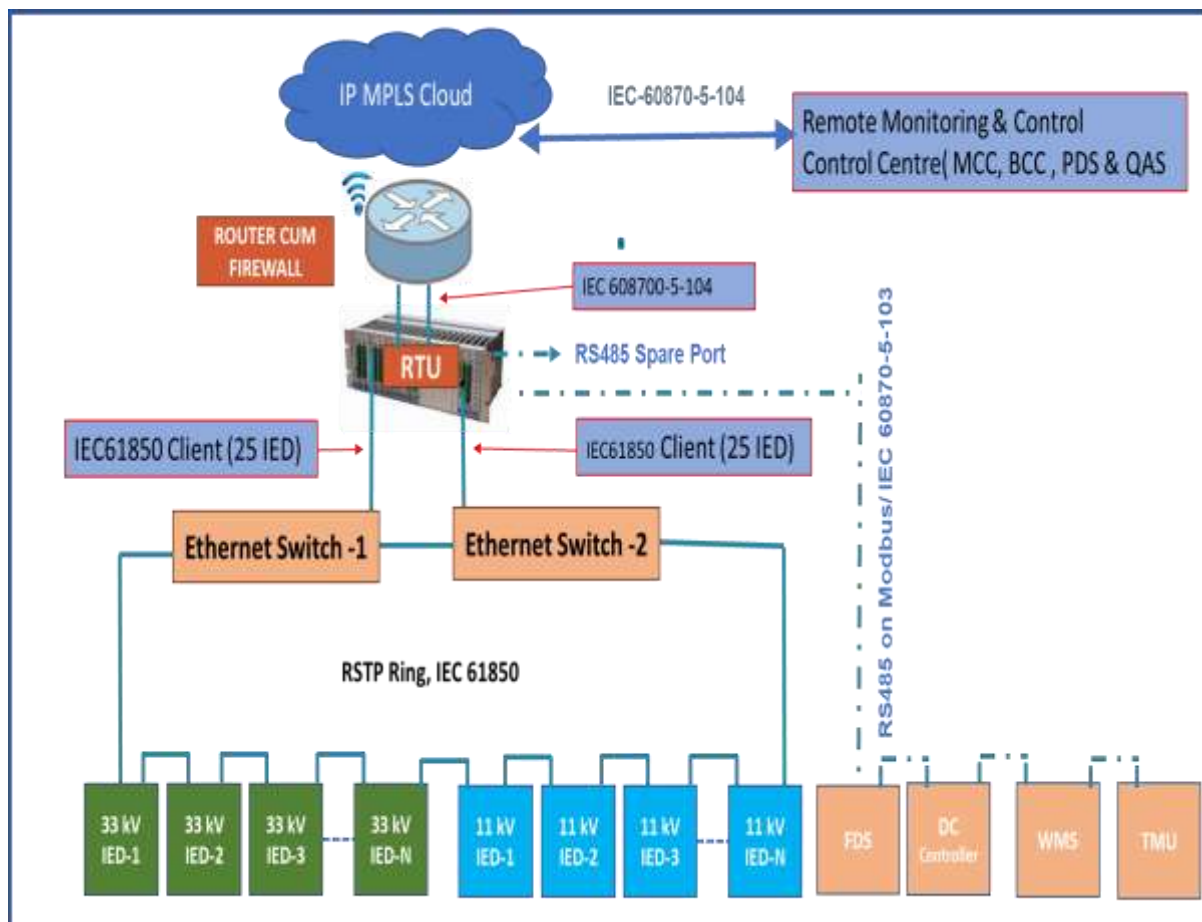
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The schematics, layouts, drawings in this section are indicative, bidder shall submit their best architecture, layout, drawings proposed as per specifications.

Annexure – 1 Indicative Proposed Sub-Station Automation System Architecture

Proposed SAS Architecture



Note for Bidder:

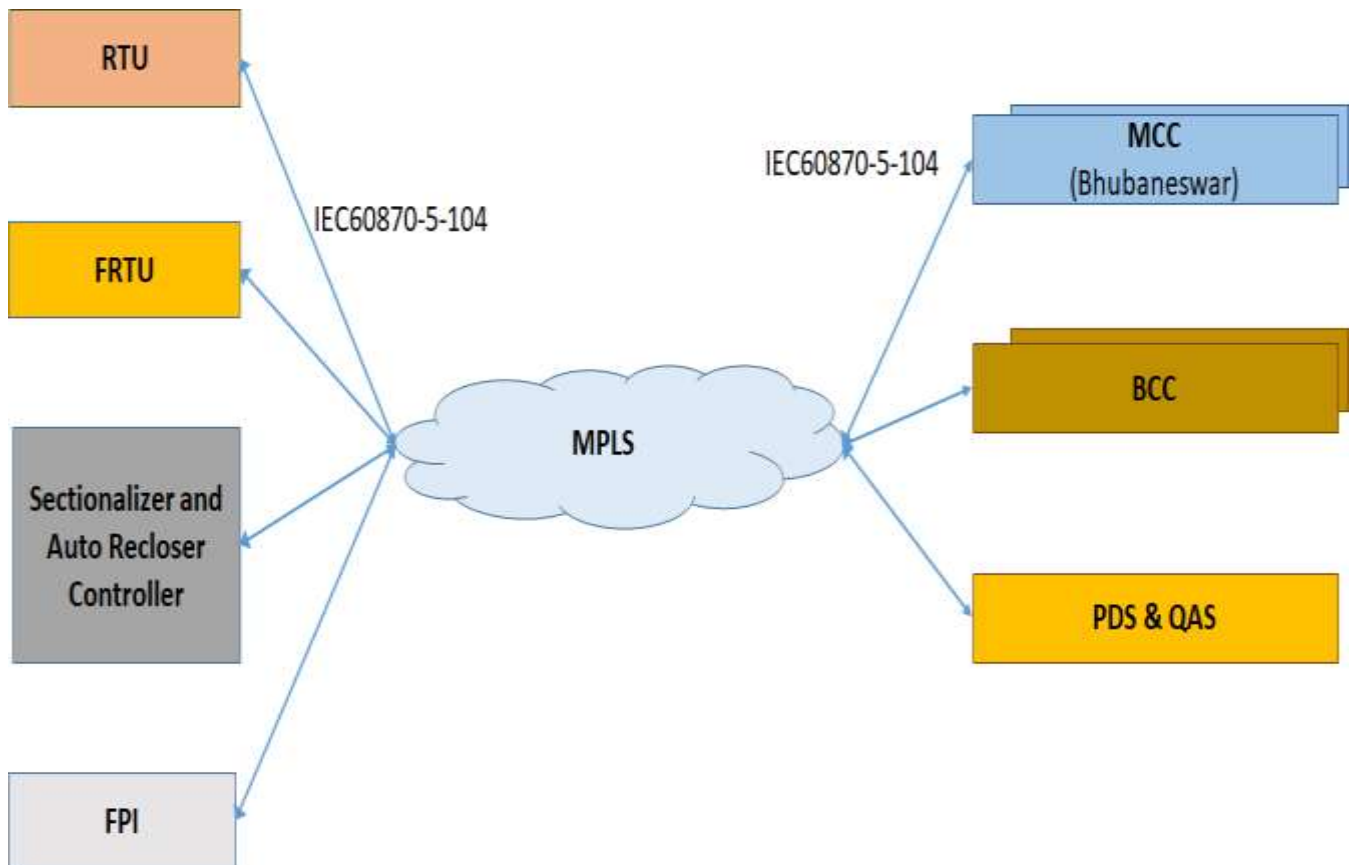
Bidder shall give more emphasis on the following aspects in the proposed architecture

- Reliability Centric
- High Availability
- Cyber Security Resilience

Legends

	CAT6 UTP Armoured / Unarmoured Cable
	4P X 0.36 mm ² Individual and Overall Shielded Communication Cable Armoured / Unarmoured Cable
	Bidder's Scope
IED	Intelligent Electronic Device – Numerical Relay (Feeder – One Number, TRF – 2 Nos.)
MFM	Multi Function Meter 0.2S with Ring CT
TMU	Transformer Monitoring Unit
RTU	Remote Terminal Unit
IPMPLS	IP Multi-Protocol Label Switching
MCC	Main Control Centre – TPCODL Bhubaneswar, Redundant System
BCC	Backup Control Centre – TPCODL Sambalpur, Redundant System
PDS & QAS	Program & Development & Quality Assurance System – at TPCODL MCC Bhubaneswar, Redundant System

Annexure – 2: Communication Architecture with Field Devices and Control Centre



Note for Bidder:

Bidder shall give more emphasis on the following aspects in the proposed architecture

- Reliability Centric
- High Availability
- Cyber Security Resilience

Annexure – 3: List of Sub-Stations, Commissioning & Integration Plan

Refer to tender document.

Annexure – 4: Indicative Signal List

Feeder Name	Description	I/O LIST FOR RTU CONFIGURATION				I/O List for As-Is Integration of Conventional Substation (With Reference to RFP)			
		DPI / SPI DPC / SPC	Type (Hardwired / Soft - IEC61850)	STATE 0	STATE 1	DPI/SPI DPC/SPC	Type (Hardwired / Soft - IEC61850)	STATE 0	STATE 1
33 kV INC Feeder	Digital Inputs								
	Equipment and Protection Status								
	Circuit Breaker	DPI	Soft	OPEN	CLOSE	DPI	Hardwired	OPEN	CLOSE
	Bus Side Isolator	DPI	Soft	OPEN	CLOSE	DPI	Hardwired	OPEN	CLOSE
	Line Side (Outdoor) Isolator	DPI	Soft	OPEN	CLOSE	DPI	Hardwired	OPEN	CLOSE
	Line Side (Indoor) Isolator	DPI	Soft	OPEN	CLOSE	DPI	Hardwired	OPEN	CLOSE
	Line Side (Outdoor) Earth Switch	DPI	Soft	OPEN	CLOSE	DPI	Hardwired	OPEN	CLOSE
	Line Side (Indoor) Earth Switch	DPI	Soft	OPEN	CLOSE	DPI	Hardwired	OPEN	CLOSE
	Circuit Breaker Spring	SPI	Soft	DISCHARGED	CHARGED	SPI	Hardwired	DISCHARGED	CHARGED
	Local / Remote Switch Position	SPI	Soft	ON LOCAL	ON REMOTE	SPI	-	ON LOCAL	ON REMOTE
	Circuit Breaker Position	SPI	Soft	IN TEST	IN SERVICE	SPI	Hardwired	IN TEST	IN SERVICE
	Master Trip Relay (86 L/O)	SPI	Soft	RESET	OPERATED	SPI	Hardwired	RESET	OPERATED

Feeder Name	Description	I/O LIST FOR RTU CONFIGURATION				I/O List for As-Is Integration of Conventional Substation (With Reference to RFP)			
		DPI / SPI DPC / SPC	Type (Hardwired / Soft - IEC61850)	STATE 0	STATE 1	DPI/SPI DPC/SPC	Type (Hardwired / Soft - IEC61850)	STATE 0	STATE 1
	Trip Circuit-1	SPI	Soft	FAILED	HEALTHY	SPI	Hardwired	FAILED	HEALTHY
	Trip Circuit-2	SPI	Soft	FAILED	HEALTHY	SPI	Hardwired	FAILED	HEALTHY
	Earth Fault Protection	SPI	Soft	RESET	OPERATED	SPI	Soft	RESET	OPERATED
	Over Current Protection R Ph	SPI	Soft	RESET	OPERATED	SPI	Soft	RESET	OPERATED
	Over Current Protection Y Ph	SPI	Soft	RESET	OPERATED	SPI	Soft	RESET	OPERATED
	Over Current Protection B Ph	SPI	Soft	RESET	OPERATED	SPI	Soft	RESET	OPERATED
	Breaker Closed from TNC Switch	SPI	Soft	-	Alarm	SPI	-	-	Alarm
	PT Fuse	SPI	Hardwired	NORMAL	FAILED	SPI	Hardwired	NORMAL	FAILED
	Bus PT MCB	SPI	Soft	OFF	ON	SPI	-	OFF	ON
	Gas Pressure (CB Compartment)	SPI	Soft	NORMAL	LOW	SPI	-	NORMAL	LOW
	Gas Pressure (CB Compartment)	SPI	Soft	RESET	TRIP	SPI	-	RESET	TRIP
	Digital Outputs								
	Equipment Control								
	Circuit Breaker	DPC	Soft	OPEN	CLOSE	DPC	Hardwired	OPEN	CLOSE
	Bus Side Isolator	DPC	Soft	OPEN	CLOSE	DPC	-	OPEN	CLOSE
	Line Side (Outdoor) Isolator	DPC	Soft	OPEN	CLOSE	DPC	-	OPEN	CLOSE
	Line Side (Indoor) Isolator	DPC	Soft	OPEN	CLOSE	DPC	-	OPEN	CLOSE
	Master Trip Relay (86 L/O)	SPC	Soft		RESET	SPC	Hardwired		RESET
	Analog Inputs								
	Equipment Analog Signals								

Feeder Name	Description	I/O LIST FOR RTU CONFIGURATION				I/O List for As-Is Integration of Conventional Substation (With Reference to RFP)			
		DPI / SPI DPC / SPC	Type (Hardwired / Soft - IEC61850)	STATE 0	STATE 1	DPI/SP I DPC/SPC	Type (Hardwired / Soft - IEC61850)	STATE 0	STATE 1
	R Phase Current (Ampere)		Modbus RS485				Modbus RS485		
	Y Phase Current (Ampere)		Modbus RS485				Modbus RS485		
	B Phase Current (Ampere)		Modbus RS485				Modbus RS485		
	TOTAL Active Power (kW)		Modbus RS485				Modbus RS485		
	TOTAL Reactive Power (kVAR)		Modbus RS485				Modbus RS485		
	RY Phase Voltage (kV)		Modbus RS485				Modbus RS485		
	YB Phase Voltage (kV)		Modbus RS485				Modbus RS485		
	BR Phase Voltage (kV)		Modbus RS485				Modbus RS485		
	Frequency (Hz)		Modbus RS485				Modbus RS485		
	Power Factor (Pf)		Modbus RS485				Modbus RS485		
	Apparent Power		Modbus RS485				Modbus RS485		
	Kwh Export	Accumulator	COUNTER RS485			Accumulator	COUNTER RS485		
	Kwh Import	Accumulator	COUNTER RS485			Accumulator	COUNTER RS485		
	KVarh Export	Accumulator	COUNTER RS485			Accumulator	COUNTER RS485		
	KVarh Import	Accumulator	COUNTER RS485			Accumulator	COUNTER RS485		
33 kV TRF Feeder	Digital Inputs								
	Equipment and Protection Status								
	Circuit Breaker	DPI	Soft	OPEN	CLOSE	DPI	Hardwired	OPEN	CLOSE

Feeder Name	Description	I/O LIST FOR RTU CONFIGURATION				I/O List for As-Is Integration of Conventional Substation (With Reference to RFP)			
		DPI / SPI DPC / SPC	Type (Hardwired / Soft - IEC61850)	STATE 0	STATE 1	DPI/SPI DPC/SPC	Type (Hardwired / Soft - IEC61850)	STATE 0	STATE 1
	Bus Side Isolator	DPI	Soft	OPEN	CLOSE	DPI	Hardwired	OPEN	CLOSE
	Bus Side Earth Switch	DPI	Soft	OPEN	CLOSE	DPI	Hardwired	OPEN	CLOSE
	Circuit Breaker Spring	SPI	Soft	DISCHARGED	CHARGED	SPI	Hardwired	DISCHARGED	CHARGED
	Local / Remote Switch Position	SPI	Soft	ON LOCAL	ON REMOTE	SPI	-	ON LOCAL	ON REMOTE
	Circuit Breaker Position	SPI	Soft	IN TEST	IN SERVICE	SPI	Hardwired	IN TEST	IN SERVICE
	Master Trip Relay (86 L/O)	SPI	Soft	RESET	OPERATED	SPI	Hardwired	RESET	OPERATED
	Trip Circuit-1	SPI	Soft	FAILED	HEALTHY	SPI	Hardwired	FAILED	HEALTHY
	Trip Circuit-2	SPI	Soft	FAILED	HEALTHY	SPI	Hardwired	FAILED	HEALTHY
	Earth Fault Protection	SPI	Soft	RESET	OPERATED	SPI	Soft	RESET	OPERATED
	Over Current Protection R Ph	SPI	Soft	RESET	OPERATED	SPI	Soft	RESET	OPERATED
	Over Current Protection Y Ph	SPI	Soft	RESET	OPERATED	SPI	Soft	RESET	OPERATED
	Over Current Protection B Ph	SPI	Soft	RESET	OPERATED	SPI	Soft	RESET	OPERATED
	Oil Level (MOG)	SPI	Soft	NORMAL	LOW ALARM	SPI	-	NORMAL	LOW ALARM
	HV Winding Temperature	SPI	Soft	NORMAL	HIGH ALARM	SPI	-	NORMAL	HIGH ALARM
	LV Winding Temperature	SPI	Soft	NORMAL	HIGH ALARM	SPI	-	NORMAL	HIGH ALARM
	Oil Temperature	SPI	Soft	NORMAL	HIGH ALARM	SPI	-	NORMAL	HIGH ALARM
	Buchholz Relay	SPI	Soft	NORMAL	ALARM	SPI	-	NORMAL	ALARM
	Bus PT MCB	SPI	Soft	OFF	ON	SPI	-	OFF	ON
	RTCC SCADA Mode	SPI	Soft	OFF	ON	SPI	-	OFF	ON

Feeder Name	Description	I/O LIST FOR RTU CONFIGURATION				I/O List for As-Is Integration of Conventional Substation (With Reference to RFP)			
		DPI / SPI DPC / SPC	Type (Hardwired / Soft - IEC61850)	STATE 0	STATE 1	DPI/SPI DPC/SPC	Type (Hardwired / Soft - IEC61850)	STATE 0	STATE 1
	RTCC AUTO Mode	SPI	Soft	OFF	ON	SPI	-	OFF	ON
	RTCC MANUAL Mode	SPI	Soft	OFF	ON	SPI	-	OFF	ON
	RTCC IN OFF Mode	SPI	Soft	OFF	ON	SPI	-	OFF	ON
	RTCC Mode In	SPI	Soft	-	FOLLOWER	SPI	-	-	FOLLOWER
	RTCC Mode In	SPI	Soft	-	MASTER	SPI	-	-	MASTER
	RTCC Mode In	SPI	Soft	-	INDEPENDENT	SPI	-	-	INDEPENDENT
	RTCC Mode	SPI	Soft	OFF	ON	SPI	-	OFF	ON
	Over Fluxing Relay	SPI	Soft	NORMAL	OPERATED	SPI	-	NORMAL	OPERATED
	Differential Relay	SPI	Soft	NORMAL	OPERATED	SPI	Soft	NORMAL	OPERATED
	Restricted Earth Fault Relay	SPI	Soft	NORMAL	OPERATED	SPI	-	NORMAL	OPERATED
	HV Winding Temperature	SPI	Soft	NORMAL	HIGH-HIGH ALARM	SPI	-	NORMAL	HIGH-HIGH ALARM
	LV Winding Temperature	SPI	Soft	NORMAL	HIGH-HIGH ALARM	SPI	-	NORMAL	HIGH-HIGH ALARM
	Oil Temperature	SPI	Soft	NORMAL	HIGH-HIGH ALARM	SPI	-	NORMAL	HIGH-HIGH ALARM
	Buchholz Relay	SPI	Soft	NORMAL	OPERATED	SPI	-	NORMAL	OPERATED
	Oil Surge Relay	SPI	Soft	NORMAL	OPERATED	SPI	-	NORMAL	OPERATED
	Pressure Relief Valve	SPI	Soft	NORMAL	OPERATED	SPI	-	NORMAL	OPERATED
	OLTC Mode	SPI	Soft	ON LOCAL	ON REMOTE	SPI	-	ON LOCAL	ON REMOTE
	Transformer TAP Position	SPI	Soft	NORMAL	OUT OF STEP	SPI	-	NORMAL	OUT OF STEP
	Breaker Closed from TNC Switch	SPI	Soft	-	Alarm	SPI	-	-	Alarm
	Gas Pressure (CB Compartment)	SPI	Soft	NORMAL	LOW	SPI	-	NORMAL	LOW

Feeder Name	Description	I/O LIST FOR RTU CONFIGURATION				I/O List for As-Is Integration of Conventional Substation (With Reference to RFP)			
		DPI / SPI DPC / SPC	Type (Hardwired / Soft - IEC61850)	STATE 0	STATE 1	DPI/SPI DPC/SPC	Type (Hardwired / Soft - IEC61850)	STATE 0	STATE 1
	Gas Pressure (CB Compartment)	SPI	Soft	RESET	TRIP	SPI	-	RESET	TRIP
	Digital Outputs								
	Equipment Control								
	Circuit Breaker	DPI	Soft	OPEN	CLOSE	DPI	Hardwired	OPEN	CLOSE
	Bus Side Isolator	DPI	Soft	OPEN	CLOSE	DPI	-	OPEN	CLOSE
	Master Trip Relay (86 L/O) / Over Current	SPC	Soft	-	RESET	SPC	Hardwired	-	RESET
	Master Trip Relay (86 L/O) / Differential Relay	SPC	Soft	-	RESET	SPC	Hardwired	-	RESET
	Transformer TAP Raise Command	SPC	Soft	-	RAISE	SPC	-	-	RAISE
	Transformer TAP Lower Command	SPC	Soft	-	LOWER	SPC	-	-	LOWER
	Analog Inputs								
	Equipment Analog Signals								
	R Phase Current (Ampere)		Modbus RS485				Modbus RS485		
	Y Phase Current (Ampere)		Modbus RS485				Modbus RS485		
	B Phase Current (Ampere)		Modbus RS485				Modbus RS485		
	TOTAL Active Power (kW)		Modbus RS485				Modbus RS485		
	TOTAL Reactive Power (kVAR)		Modbus RS485				Modbus RS485		
	RY Phase Voltage (kV)		Modbus RS485				Modbus RS485		
	YB Phase Voltage (kV)		Modbus RS485				Modbus RS485		
	BR Phase Voltage (kV)		Modbus RS485				Modbus RS485		

Feeder Name	Description	I/O LIST FOR RTU CONFIGURATION				I/O List for As-Is Integration of Conventional Substation (With Reference to RFP)			
		DPI / SPI DPC / SPC	Type (Hardwired / Soft - IEC61850)	STATE 0	STATE 1	DPI/SPI DPC/SPC	Type (Hardwired / Soft - IEC61850)	STATE 0	STATE 1
	Frequency (Hz)		Modbus RS485				Modbus RS485		
	Power Factor (Pf)		Modbus RS485				Modbus RS485		
	Apparent Power		Modbus RS485				Modbus RS485		
	Kwh Export	Accumulator	COUNTER RS485			Accumulator	COUNTER RS485		
	Kwh Import	Accumulator	COUNTER RS485			Accumulator	COUNTER RS485		
	KVarh Export	Accumulator	COUNTER RS485			Accumulator	COUNTER RS485		
	KVarh Import	Accumulator	COUNTER RS485			Accumulator	COUNTER RS485		
	HV Winding Temperature Indication		HARD WIRING				-		
	LV Winding Temperature Indication		HARD WIRING				-		
	Oil Temp Indication		HARD WIRING				-		
	Transformer TAP Position		HARD WIRING				-		
11 kV INC Feeder	Digital Inputs								
	Equipment and Protection Status								
	Circuit Breaker	DPI	Soft	OPEN	CLOSE	DPI	Hardwired	OPEN	CLOSE
	Circuit Breaker Spring	SPI	Soft	DISCHARGED	CHARGED	SPI	Hardwired	DISCHARGED	CHARGED
	Local / Remote Switch Position	SPI	Soft	ON LOCAL	ON REMOTE	SPI	-	ON LOCAL	ON REMOTE
	Circuit Breaker Position	SPI	Soft	IN TEST	IN SERVICE	SPI	Hardwired	IN TEST	IN SERVICE
	Master Trip Relay (86 L/O)	SPI	Soft	RESET	OPERATED	SPI	Hardwired	RESET	OPERATED

Feeder Name	Description	I/O LIST FOR RTU CONFIGURATION				I/O List for As-Is Integration of Conventional Substation (With Reference to RFP)			
		DPI / SPI DPC / SPC	Type (Hardwired / Soft - IEC61850)	STATE 0	STATE 1	DPI/SPI DPC/SPC	Type (Hardwired / Soft - IEC61850)	STATE 0	STATE 1
	Trip Circuit-1	SPI	Soft	FAILED	HEALTHY	SPI	Hardwired	FAILED	HEALTHY
	Trip Circuit-2	SPI	Soft	FAILED	HEALTHY	SPI	Hardwired	FAILED	HEALTHY
	Earth Fault Protection	SPI	Soft	RESET	OPERATED	SPI	Soft	RESET	OPERATED
	Over Current Protection R Ph	SPI	Soft	RESET	OPERATED	SPI	Soft	RESET	OPERATED
	Over Current Protection Y Ph	SPI	Soft	RESET	OPERATED	SPI	Soft	RESET	OPERATED
	Over Current Protection B Ph	SPI	Soft	RESET	OPERATED	SPI	Soft	RESET	OPERATED
	Breaker Closed from TNC Switch	SPI	Soft	-	Alarm	SPI	-	-	Alarm
	Bus PT MCB	SPI	Soft	OFF	ON	SPI	-	OFF	ON
Digital Outputs									
Equipment Control									
	Circuit Breaker	DPC	Soft	OPEN	CLOSE	DPC	Hardwired	OPEN	CLOSE
	Master Trip Relay (86 L/O)	SPC	Soft	-	RESET	SPC	Hardwired	-	RESET
Analog Inputs									
Equipment Analog Signals									
	R Phase Current (Ampere)		Modbus RS485				Modbus RS485		
	Y Phase Current (Ampere)		Modbus RS485				Modbus RS485		
	B Phase Current (Ampere)		Modbus RS485				Modbus RS485		
	TOTAL Active Power (kW)		Modbus RS485				Modbus RS485		
	TOTAL Reactive Power (kVAR)		Modbus RS485				Modbus RS485		
	RY Phase Voltage (kV)		Modbus RS485				Modbus RS485		

Feeder Name	Description	I/O LIST FOR RTU CONFIGURATION				I/O List for As-Is Integration of Conventional Substation (With Reference to RFP)			
		DPI / SPI DPC / SPC	Type (Hardwired / Soft - IEC61850)	STATE 0	STATE 1	DPI/SPI DPC/SPC	Type (Hardwired / Soft - IEC61850)	STATE 0	STATE 1
	YB Phase Voltage (kV)		Modbus RS485				Modbus RS485		
	BR Phase Voltage (kV)		Modbus RS485				Modbus RS485		
	Frequency (Hz)		Modbus RS485				Modbus RS485		
	Power Factor (Pf)		Modbus RS485				Modbus RS485		
	Apparent Power		Modbus RS485				Modbus RS485		
	Kwh Export	Accumulator	COUNTER RS485			Accumulator	COUNTER RS485		
	Kwh Import	Accumulator	COUNTER RS485			Accumulator	COUNTER RS485		
	KVarh Export	Accumulator	COUNTER RS485			Accumulator	COUNTER RS485		
	KVarh Import	Accumulator	COUNTER RS485			Accumulator	COUNTER RS485		
11kV Bus Coupler	Digital Inputs								
	Equipment Status								
	Circuit Breaker	DPI	Soft	OPEN	CLOSE	DPI	Hardwired	OPEN	CLOSE
	Circuit Breaker Spring	SPI	Soft	DISCHARGED	CHARGED	SPI	Hardwired	DISCHARGED	CHARGED
	Local / Remote Switch Position	SPI	Soft	ON LOCAL	ON REMOTE	SPI	-	ON LOCAL	ON REMOTE
	Circuit Breaker Position	SPI	Soft	IN TEST	IN SERVICE	SPI	Hardwired	IN TEST	IN SERVICE
	Trip Circuit-1	SPI	Soft	FAILED	HEALTHY	SPI	Hardwired	FAILED	HEALTHY
	Trip Circuit-2	SPI	Soft	FAILED	HEALTHY	SPI	Hardwired	FAILED	HEALTHY
	Earth Fault Protection	SPI	Soft	RESET	OPERATED	SPI	Soft	RESET	OPERATED
	Over Current Protection R Ph	SPI	Soft	RESET	OPERATED	SPI	Soft	RESET	OPERATED

Feeder Name	Description	I/O LIST FOR RTU CONFIGURATION				I/O List for As-Is Integration of Conventional Substation (With Reference to RFP)			
		DPI / SPI DPC / SPC	Type (Hardwired / Soft - IEC61850)	STATE 0	STATE 1	DPI/SPI DPC/SPC	Type (Hardwired / Soft - IEC61850)	STATE 0	STATE 1
	Over Current Protection Y Ph	SPI	Soft	RESET	OPERATED	SPI	Soft	RESET	OPERATED
	Over Current Protection B Ph	SPI	Soft	RESET	OPERATED	SPI	Soft	RESET	OPERATED
	Breaker Closed from TNC Switch	SPI	Soft	-	Alarm	SPI	-	-	Alarm
	Bus PT MCB	SPI	Soft	OFF	ON	SPI	-	OFF	ON
Digital Outputs									
Equipment Control									
	Circuit Breaker	DPC	Soft	OPEN	CLOSE	DPC	Hardwired	OPEN	CLOSE
Analog Inputs									
Equipment Analog Signals									
	R Phase Current (Ampere)		Modbus RS485				Modbus RS485		
	Y Phase Current (Ampere)		Modbus RS485				Modbus RS485		
	B Phase Current (Ampere)		Modbus RS485				Modbus RS485		
	TOTAL Active Power (kW)		Modbus RS485				Modbus RS485		
	TOTAL Reactive Power (kVAR)		Modbus RS485				Modbus RS485		
	RY Phase Voltage (kV)		Modbus RS485				Modbus RS485		
	YB Phase Voltage (kV)		Modbus RS485				Modbus RS485		
	BR Phase Voltage (kV)		Modbus RS485				Modbus RS485		
	Frequency (Hz)		Modbus RS485				Modbus RS485		
	Power Factor (Pf)		Modbus RS485				Modbus RS485		

Feeder Name	Description	I/O LIST FOR RTU CONFIGURATION				I/O List for As-Is Integration of Conventional Substation (With Reference to RFP)			
		DPI / SPI DPC / SPC	Type (Hardwired / Soft - IEC61850)	STATE 0	STATE 1	DPI/SPI DPC/SPC	Type (Hardwired / Soft - IEC61850)	STATE 0	STATE 1
	Apparent Power		Modbus RS485				Modbus RS485		
	Kwh Export	Accumulator	COUNTER RS485			Accumulator	COUNTER RS485		
	Kwh Import	Accumulator	COUNTER RS485			Accumulator	COUNTER RS485		
	KVarh Export	Accumulator	COUNTER RS485			Accumulator	COUNTER RS485		
	KVarh Import	Accumulator	COUNTER RS485			Accumulator	COUNTER RS485		
11kV O/G Feeder	Digital Inputs								
	Equipment and Protection Status								
	Circuit Breaker	DPI	Soft	OPEN	CLOSE	DPI	Hardwired	OPEN	CLOSE
	Bus Side Isolator	DPI	Soft	OPEN	CLOSE	DPI	Hardwired	OPEN	CLOSE
	Line Side Isolator	DPI	Soft	OPEN	CLOSE	DPI	Hardwired	OPEN	CLOSE
	Outdoor Isolator	DPI	Soft	OPEN	CLOSE	DPI	Hardwired	OPEN	CLOSE
	Outdoor Earth Switch	DPI	Soft	OPEN	CLOSE	DPI	Hardwired	OPEN	CLOSE
	Circuit Breaker Spring	SPI	Soft	DISCHARGED	CHARGED	SPI	Hardwired	DISCHARGED	CHARGED
	Local / Remote Switch Position	SPI	Soft	ON LOCAL	ON REMOTE	SPI	-	ON LOCAL	ON REMOTE
	Circuit Breaker Position	SPI	Soft	IN TEST	IN SERVICE	SPI	Hardwired	IN TEST	IN SERVICE
	Master Trip Relay (86 L/O)	SPI	Soft	RESET	OPERATED	SPI	Hardwired	RESET	OPERATED
	Trip Circuit-1	SPI	Soft	FAILED	HEALTHY	SPI	Hardwired	FAILED	HEALTHY
	Trip Circuit-2	SPI	Soft	FAILED	HEALTHY	SPI	Hardwired	FAILED	HEALTHY
	Earth Fault Protection	SPI	Soft	RESET	OPERATED	SPI	Soft	RESET	OPERATED

Feeder Name	Description	I/O LIST FOR RTU CONFIGURATION				I/O List for As-Is Integration of Conventional Substation (With Reference to RFP)			
		DPI / SPI DPC / SPC	Type (Hardwired / Soft - IEC61850)	STATE 0	STATE 1	DPI/SPI DPC/SPC	Type (Hardwired / Soft - IEC61850)	STATE 0	STATE 1
	Over Current Protection R Ph	SPI	Soft	RESET	OPERATED	SPI	Soft	RESET	OPERATED
	Over Current Protection Y Ph	SPI	Soft	RESET	OPERATED	SPI	Soft	RESET	OPERATED
	Over Current Protection B Ph	SPI	Soft	RESET	OPERATED	SPI	Soft	RESET	OPERATED
	Breaker Closed from TNC Switch	SPI	Soft	-	Alarm	SPI	-	-	Alarm
	Bus PT MCB	SPI	Soft	OFF	ON	SPI	-	OFF	ON
Digital Outputs									
Equipment Control									
	Circuit Breaker	DPC	Soft	OPEN	CLOSE	DPC	Hardwired	OPEN	CLOSE
	Bus Side Isolator	DPC	Soft	OPEN	CLOSE	DPC	-	OPEN	CLOSE
	Line Side Isolator	DPC	Soft	OPEN	CLOSE	DPC	-	OPEN	CLOSE
	Outdoor Isolator	DPC	Soft	OPEN	CLOSE	DPC	-	OPEN	CLOSE
	Master Trip Relay (86 L/O)	SPC	Soft		RESET	SPC	Hardwired		RESET
Analog Inputs									
Equipment Analog Signals									
	R Phase Current (Ampere)		Modbus RS485				Modbus RS485		
	Y Phase Current (Ampere)		Modbus RS485				Modbus RS485		
	B Phase Current (Ampere)		Modbus RS485				Modbus RS485		
	TOTAL Active Power (kW)		Modbus RS485				Modbus RS485		
	TOTAL Reactive Power (kVAR)		Modbus RS485				Modbus RS485		
	RY Phase Voltage (kV)		Modbus RS485				Modbus RS485		

Feeder Name	Description	I/O LIST FOR RTU CONFIGURATION				I/O List for As-Is Integration of Conventional Substation (With Reference to RFP)			
		DPI / SPI DPC / SPC	Type (Hardwired / Soft - IEC61850)	STATE 0	STATE 1	DPI/SPI DPC/SPC	Type (Hardwired / Soft - IEC61850)	STATE 0	STATE 1
	YB Phase Voltage (kV)		Modbus RS485				Modbus RS485		
	BR Phase Voltage (kV)		Modbus RS485				Modbus RS485		
	Frequency (Hz)		Modbus RS485				Modbus RS485		
	Power Factor (Pf)		Modbus RS485				Modbus RS485		
	Apparent Power		Modbus RS485				Modbus RS485		
	Kwh Export	Accumulator	COUNTER RS485			Accumulator	COUNTER RS485		
	Kwh Import	Accumulator	COUNTER RS485			Accumulator	COUNTER RS485		
	KVarh Export	Accumulator	COUNTER RS485			Accumulator	COUNTER RS485		
	KVarh Import	Accumulator	COUNTER RS485			Accumulator	COUNTER RS485		
Misc Alarms, Control & Analog	Digital Inputs								
	Miscellaneous Station Alarms								
	Dummy Breaker Status	DPI	HARDWIRED	OPEN	CLOSE	DPI	Soft	OPEN	CLOSE
	Battery Charger Input AC Supply	SPI	HARDWIRED	NORMAL	FAILED	SPI	Soft	NORMAL	FAILED
	Battery Charger Failure	SPI	HARDWIRED	NORMAL	ALARM	SPI	Soft	NORMAL	ALARM
	DC System Earth Fault	SPI	HARDWIRED	NORMAL	OPERATED	SPI	Soft	NORMAL	OPERATED
	Battery Charger Group	SPI	HARDWIRED	NORMAL	ALARM	SPI	Soft	NORMAL	ALARM
	RTU Local / Remote Switch Position	SPI	HARDWIRED	ON LOCAL	ON REMOTE	SPI	HARDWIRED	ON LOCAL	ON REMOTE
	RTU - Power Supply	SPI	Soft	NORMAL	FAILED	SPI	Hardwired	NORMAL	FAILED

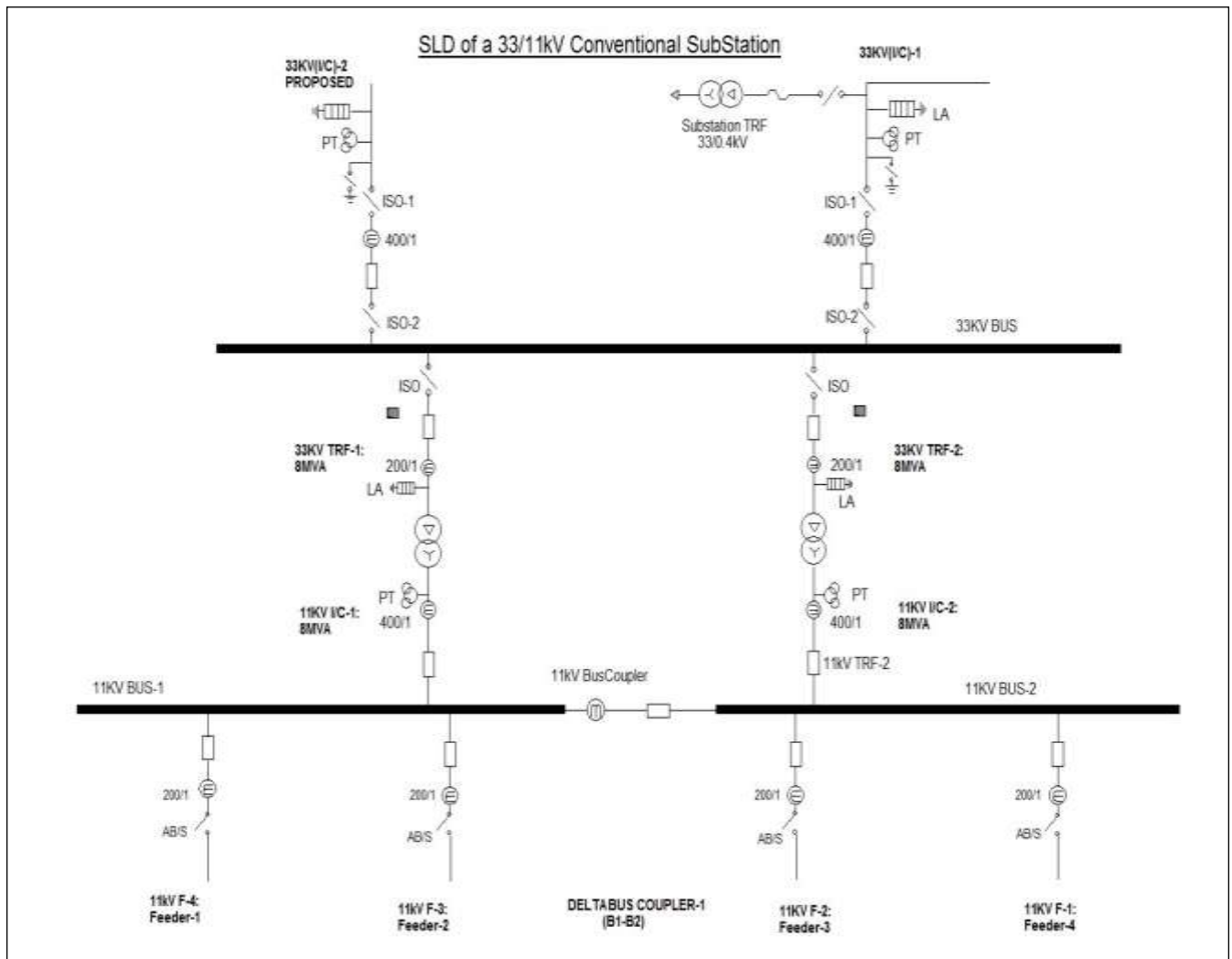
Feeder Name	Description	I/O LIST FOR RTU CONFIGURATION				I/O List for As-Is Integration of Conventional Substation (With Reference to RFP)			
		DPI / SPI DPC / SPC	Type (Hardwired / Soft - IEC61850)	STATE 0	STATE 1	DPI/SPI DPC/SPC	Type (Hardwired / Soft - IEC61850)	STATE 0	STATE 1
	Main RTU CPU Module	SPI	Soft	NORMAL	FAILED	SPI	Soft	NORMAL	FAILED
	Slave RTU CPU Module	SPI	Soft	NORMAL	FAILED	SPI	Soft	NORMAL	FAILED
	RIO RTU Rack	SPI	Soft	NORMAL	FAILED	SPI	Soft	NORMAL	FAILED
	RTU Managed Ethernet Switch	SPI	Soft	UNHEALTHY	HEALTHY	SPI	Soft	UNHEALTHY	HEALTHY
	Time Synchronization of RTU	SPI	Soft	UNHEALTHY	HEALTHY	SPI	Soft	UNHEALTHY	HEALTHY
	Time Synchronization of IEDs	SPI	Soft	UNHEALTHY	HEALTHY	SPI	Soft	UNHEALTHY	HEALTHY
	RTU - DI Module-1	SPI	Soft	NORMAL	FAILED	SPI	Soft	NORMAL	FAILED
	RTU - DI Module-2	SPI	Soft	NORMAL	FAILED	SPI	Soft	NORMAL	FAILED
	RTU - DI Module-3	SPI	Soft	NORMAL	FAILED	SPI	Soft	NORMAL	FAILED
	RTU - DO Module-1	SPI	Soft	NORMAL	FAILED	SPI	Soft	NORMAL	FAILED
	RTU - DO Module-2	SPI	Soft	NORMAL	FAILED	SPI	Soft	NORMAL	FAILED
	RTU - AI Module-1	SPI	Soft	NORMAL	FAILED	SPI	Soft	NORMAL	FAILED
	RTU - AI Module-2	SPI	Soft	NORMAL	FAILED	SPI	Soft	NORMAL	FAILED
	33 kV Incomer-1 MFM Communication	SPI	Soft	NORMAL	FAILED	SPI	Soft	NORMAL	FAILED
	33 kV Incomer-2 MFM Communication	SPI	Soft	NORMAL	FAILED	SPI	Soft	NORMAL	FAILED
	33 kV Trf-1 MFM Communication	SPI	Soft	NORMAL	FAILED	SPI	Soft	NORMAL	FAILED
	33 kV Trf-2 MFM Communication	SPI	Soft	NORMAL	FAILED	SPI	Soft	NORMAL	FAILED
	11 kV Incomer-1 MFM Communication	SPI	Soft	NORMAL	FAILED	SPI	Soft	NORMAL	FAILED

Feeder Name	Description	I/O LIST FOR RTU CONFIGURATION				I/O List for As-Is Integration of Conventional Substation (With Reference to RFP)			
		DPI / SPI DPC / SPC	Type (Hardwired / Soft - IEC61850)	STATE 0	STATE 1	DPI/SPI DPC/SPC	Type (Hardwired / Soft - IEC61850)	STATE 0	STATE 1
	11 kV Incomer-2 MFM Communication	SPI	Soft	NORMAL	FAILED	SPI	Soft	NORMAL	FAILED
	11 kV Bus Coupler MFM Communication	SPI	Soft	NORMAL	FAILED	SPI	Soft	NORMAL	FAILED
	11 kV Outgoing FDR-1 MFM Communication	SPI	Soft	NORMAL	FAILED	SPI	Soft	NORMAL	FAILED
	11 kV Outgoing FDR-2 MFM Communication	SPI	Soft	NORMAL	FAILED	SPI	Soft	NORMAL	FAILED
	11 kV Outgoing FDR-3 MFM Communication	SPI	Soft	NORMAL	FAILED	SPI	Soft	NORMAL	FAILED
	11 kV Outgoing FDR-4 MFM Communication	SPI	Soft	NORMAL	FAILED	SPI	Soft	NORMAL	FAILED
	33 kV Incomer-1 BCPU	SPI	Soft	NORMAL	FAILED	SPI	-	NORMAL	FAILED
	33 kV Incomer-2 BCPU	SPI	Soft	NORMAL	FAILED	SPI	-	NORMAL	FAILED
	33 kV Trf-1 BCPU-1	SPI	Soft	NORMAL	FAILED	SPI	-	NORMAL	FAILED
	33 kV Trf-1 BCPU-2	SPI	Soft	NORMAL	FAILED	SPI	-	NORMAL	FAILED
	33 kV Trf-2 BCPU-1	SPI	Soft	NORMAL	FAILED	SPI	-	NORMAL	FAILED
	33 kV Trf-2 BCPU-2	SPI	Soft	NORMAL	FAILED	SPI	-	NORMAL	FAILED
	11 kV Incomer-1 BCPU	SPI	Soft	NORMAL	FAILED	SPI	-	NORMAL	FAILED
	11 kV Incomer-2 BCPU	SPI	Soft	NORMAL	FAILED	SPI	-	NORMAL	FAILED
	11 kV Outgoing FDR-1 BCPU	SPI	Soft	NORMAL	FAILED	SPI	-	NORMAL	FAILED
	11 kV Outgoing FDR-2 BCPU	SPI	Soft	NORMAL	FAILED	SPI	-	NORMAL	FAILED
	11 kV Outgoing FDR-3 BCPU	SPI	Soft	NORMAL	FAILED	SPI	-	NORMAL	FAILED
	11 kV Outgoing FDR-4 BCPU	SPI	Soft	NORMAL	FAILED	SPI	-	NORMAL	FAILED

Feeder Name	Description	I/O LIST FOR RTU CONFIGURATION				I/O List for As-Is Integration of Conventional Substation (With Reference to RFP)			
		DPI / SPI DPC / SPC	Type (Hardwired / Soft - IEC61850)	STATE 0	STATE 1	DPI/SPI DPC/SPC	Type (Hardwired / Soft - IEC61850)	STATE 0	STATE 1
	Fire Protection System	SPI	Soft	NORMAL	OPERATED	SPI	Hardwired	NORMAL	OPERATED
	Fire Protection System	SPI	Soft	NORMAL	OPERATED	SPI	Soft	NORMAL	OPERATED
Digital Outputs									
Equipment Control									
	Dummy Breaker Control	DPC	HARDWIRED	OFF	ON	DPC	HARDWIRED	OFF	ON
	Fire Protection Alarm Hooter	SPC	HARDWIRED		Reset	SPC	HARDWIRED		Reset
	Fire Protection Alarm Hooter	SPC	Soft		Reset	SPC	Soft		Reset
Analog Inputs									
Equipment Analog Signals									
	Battery Charger Voltage (Volt)	Analog	HARDWIRED			Analog	HARDWIRED		
	Battery Charger Current (Ampere)	Analog	HARDWIRED			Analog	HARDWIRED		
	Substation Temperature	Analog	Soft			Analog	Soft		
	Substation Humidity	Analog	Soft			Analog	Soft		

Bidder to note that the Analog Parameters can be acquired either from Multifunction Meter or from the BCPU. Same will be finalized during site survey as proposed before placement of RO or during detailed engineering for the respective Substation.

Annexure – 5: Typical Single Line Substation Layout



Annexure – 6: Preferred/Approved Make of Equipment/System

Sl. No.	Item Description	Preferred Make / Model
1	RTU	HEIL / SIEMENS / SCHNEIDER / GE / Other reputed Make (to be approved by Engineering)
2	Engineering / Configuration Laptop	Dell / HP / Lenovo / IBM
3	Industrial Grade RTU Panels (42U)	Rittal/Siemens/Pyrotech
4	Layer 2 Managed Ethernet Switch	Ruggedcom / Hirschman / MOXA / Other reputed Make (to be approved by Engineering)
5	I/O Boxes	Systemax / Tyco / CommScope
6	Armored UTP CAT6 Cable	Systemax / Tyco / CommScope
7	Unarmored UTP Cable	Systemax / Tyco / CommScope
8	Patch Panel (RJ45) with Connectors, I/O boxes	Systemax / Tyco / CommScope
9	CAT6 UTP Patch Chords	Systemax / Tyco / CommScope
10	4P X 0.36 Sq.mm. Armored Communication Cable (Multistrand, individual pair and overall shielded)	BELDEN / LAPP / SATYAM
11	4P X 0.36 Sq.mm. Unarmored Communication Cable (Multistrand, individual pair & overall shielded)	BELDEN / LAPP / SATYAM
12	RS 232 / RS 485 converter	MOXA / Advantech
13	DC-DC Converter	Cossel / Phoenix / Paramount
14	Diode-Oring Unit	Paramount / Phoenix
15	Droppable type Terminal Block for Digital Output, CT & PT	Connect well – CBT4U or equivalent
16	Disconnecting type (Knife edge) Terminal Block for Digital Input	Connect well – CKT4U or equivalent
17	Modbus TCP/IP converter (Serial Server)	Siemens, Moxa, Advantech, Ruggedcom
19	Multifunction Meter	SATEC, PM130EH+ or Equivalent
20	Auxiliary Relays	OMRON / ABB / Sulzer / OEN / Paramount
21	Control Cable	CCI / FORT GLOSTER / FINOLEX / HAVELLS / Indian aluminum Cables / Universal Cables /

Sl. No.	Item Description	Preferred Make / Model
		Incab / Asian Cable / KEI / Polycab / Ruchika
22	MCB	Siemens / Schneider / Anchor / Havells
23	SPD	Moxa/Phoenix/RTEK

Annexure – 7: Guaranteed Technical Particulars (GTP) SAS Specification for Conventional Substation

Annexure – 7 (a) Remote Terminal Unit (RTU)

SL. NO.	TECHNICAL PARTICULARS	TP ODISHA REQUIREMENT	BIDDER RESPONSE
1	Remote Terminal Units (RTU)	19" Modular / Din Rail Mounted It shall have capability to be part of a larger BCU/RTU family for T&D function	
2.1	Make	HEIL / SIEMENS / SCHNEIDER / GE / Other reputed Make (to be approved by Engineering)	
2.2	Model	Suitable as per RFP	
3	RTU Redundancy	1. Redundant processor with minimum dual ethernet port. 2. Each processor with minimum 4x RS485 Serial port (Option of adding additional Serial ports) 3. Redundant Power supply	
4	Digital Inputs (Physical)	16 DI Expandable upto 48 DI	
5	Digital Outputs (Physical)	8 DO Expandable upto 24 DO	
	Close / Open	Required	
	Raise / Lower	Required	
6	Analog Inputs (Physical)	4 AI Expandable upto 8 AI	
7	Energy Meters / Numerical Relays Integration	Facility to interface Multifunction Meters and Numerical Relays	
8	Distributed I/O modules	Required	
9	Ports Requirement and Type	All ports shall be galvanically isolated	
		Redundant 4x. RS 485 electrical ports for communication with serial devices over IEC60870-5-103, Modbus and IEC 60870-5-101 protocol in the RTU. To meet the additional RS485 ports requirement, Bidder shall propose Industrial grade Serial Server of 8 Ports as an optional item. This server shall communicate with RTU on Modbus TCP/IP protocol or Open Protocol as considered in the RTU.	
		Redundant 2x Ethernet Ports(Both for simultaneous Communication over IEC 104, Modbus TCP/IP & IEC61850)	
	For Structuring (Configuration) System (Separate Port)	A galvanically isolated USB port for local engineering through laptop	

10	Protocol Support	IEC 61850, IEC 60870-5-103, IEC60870-5-104 (Master & Slave), MODBUS (TCP/IP & RTU), SNTP & SNMP with Server and Client licenses	
11	Time synchronization between RTU, I/O modules, IEDs and Gateway	RTU to capable synchronization over IEC-104 from SCADA & SNTP through dedicated GPS Server. IED synchronization over SNTP Protocol.	
	Real time stamping at RTU level, I/O level	Required, Mandatory	
12	Response Time		
	Digital Input	1 msec or better	
	Analog Measurement	1 sec or better	
	Digital Output	<1 sec or better	
13	I/O handling Capacity	Min 10000 Tags / RTU	
14	Pseudo Points (Digital, Analog)	Required	
15	Calculated Points (Digital, Analog)	Required	
16	SOE List storage	Min 2000 (shall be user configurable)	
	SOE list Retention Period	FIFO supported by battery backup of upto 3 Months	
17	Fault Disturbance Recorder	1000 events	
	FDR Retention Period	1 Month	
18	Development of Interlock logic	Required, Mandatory	
19	Support of mathematical function - Arithmetic, Logical, Trigonometric functions, Differential and Integration functions, Timer, Counter etc.	Required, Mandatory	
20	Logic and Calculation functionality	Required, Mandatory	
21	Check-Before-Execute Scheme for Control	Required (Bidder shall submit their Check-before-Execute scheme)	
22	Auxiliary Relays for Digital Outputs	Required, Auxiliary relays with Min 10 Ampere rating with 2 NO contacts (to be wired in Series) for each digital outputs	
23	Status LEDs on all module – for fault indication and Inputs / Outputs	Required	
24	Module replacement in RTU	Hot-Swappable module	
25	Software – All diagnostic tools, simulator tool, maintenance tools, configuration application for database and process control program development, documentation and maintenance	Required	

26	Engineering Functions	a) Configuration shall be possible both locally and remotely	
		b) RTU shall have multilevel passwords	
		c) On-line monitoring facility of real time data for monitoring/analyzing the real time status of the process, program logic from the engineering station	
		d) Allow configuration of the RTU with different versions of the Configuration Tool	
		e) ICD file generation shall be possible from the proposed Configuration Tool	
		f) RTU must have the provision to configure the IP of the redundant SCADA Systems (Socket IP)	
27	Cyber Security	Bidder to confirm Cyber security measures as indicated in the Specification	
28	Battery Backup / Flash-PROM backup	Required	
29	Auxiliary Power Supply	Redundant 18-72 VDC (24/48V DC) Supply with Diode Oring unit and MCBs with add-on NO contact. The RTU shall have adequate protection against reversed polarity, over current and under voltage conditions, to prevent the internal logic from being damaged and becoming unstable causing mal-operation	
29.1	Auto-Startup Restoration and	In case of Power Supply Failure, Auto-Startup and Restoration of the RTU required	
30	RTU health monitoring contacts (CPU, Communication, I/O modules, Power Supply)	Required both Physical and Soft, Mandatory	
31	Environment Requirement, Reliability & Cooling	RTU with accessories will be installed in the Relay/Control room with no temperature or humidity control. The RTU shall be capable of operating in ambient temperature from 0 to +65 degree C with rate of temperature change of 20 degree C/hour and relative humidity of 95%, non-condensing	
		All the modules shall be with conformal coating	
32	MTBF Value	Minimum expected MTBF Value 300000 hours	
33	Training Module	Video Manual & QR Code for accessing manual	

Annexure- 7 (b) - Managed Layer - 2 Ethernet Switch

SL. NO.	TECHNICAL PARTICULARS	TP ODISHA REQUIREMENT	BIDDER RESPONSE
1	Make	Ruggedcom / Hirschman / MOXA / Other reputed Make (to be approved by Engineering)	
2	Model		
3	Type of Switch	Industrial Grade, Din Rail mountable	
4	No. of Ports per switch	Minimum 16	
4.1	No. of Copper ports (10/100 mbps)	Minimum 16ports	
5	Compliance		
5.1	Shall support 802.1Q VLAN, 802.2p, 802.1d STP, 802.3ad (Port aggregation), 802.1w RSTP, 802.1s MSTP, 802.3ad LACP, IEEE 802.1ab Link Layer Discovery Protocol and also suitable for Ring Configuration	Required	
5.2	IEEE 1613 compliance	Mandatory	
5.3	IEC 61850 Compliance	Mandatory	
5.4	QAS (802.1p)	Mandatory	
6	Time Synchronization	SNTP	
7	Suitable for PRP/HSR architecture	Optional	
8	Other Required Features	Automatic Learning, Negotiation, and Crossover Detection	
		Support Industrial Automation Protocols i.e. IEC61850, MODBUS, Ethernet/IP etc.	
		Shall support Layer 2 switch ports with Secure VTP or similar protocols to reduce administrative burden for VLANs Configuration	
		Shall support both Rapid Spanning Tree Protocol (RSTP) & Multiple Spanning Tree Protocol (MSTP)	
		Port Mirroring	
		Discover the neighboring device, giving the details about the platform, IP Address, Link connected through etc.	
		Shall support to prevent edge devices not in the network administrator's control from becoming STP root nodes	
		Shall support configurable SNMP traps	

9	Management Tools support	Web-based, Telnet & Command Line Interface (CLI) for quickly configuring major managed functions	
		SNMPv1/v2c/v3 for different levels of network management	
		Remote Monitoring (RMON)	
		Rich set of diagnostics with logging and alarms	
10	Auxiliary Power Supply	Power supply module of 18-72V DC shall be available (Based on the Architecture proposal).The Switch shall have in-built adequate protection against reversed polarity, over current and under voltage conditions, to prevent the internal logic from being damaged and becoming unstable causing mal-operation	
11	Health Monitoring of Hardware such as Ethernet ports, Power supply cards & Communication links and internal voltages through SNMP/IEC61850 to SCADA System/Purchaser's NMS	Protocol shall be SNMP	
12	Environment Requirement, Reliability & Cooling	Switch with accessories will be installed in the Relay Panel/Switchgear with no temperature or humidity control. The Switch shall be capable of operating in ambient temperature from 0 to +65 degree C with rate of temperature change of 20 degree C/hour and relative humidity of 95%, non-condensing	
		All the modules shall be with conformal coating	

Annexure- 7 (c)- Multi- Function Meter (MFM)

SL. NO.	TECHNICAL PARTICULARS	TPCODL REQUIREMENT	BIDDER RESPONSE
1	Make	SATEC, PM130EH+ or equivalent reputed make (to be approved by Engineering)	
2	Model		
3	Accuracy Class	0.2S/0.5S as per IEC62053:11, IEC62053:21, IEC62053-22, IEC62053-23, IEC62053-31, IEC61010, IS13779, IS14697,	
4	Sampling rate	80 Samples/Cycle for true RMS measurement	
5	Voltage Input	0 to 690 V L-L, 400 V L-N	
	Voltage Burden	< 0.15 VA	
	PT Ratio	1.0 - 6500	
	Primary Value of PT	Shall be programmable	
	Range of Reading	1 - 999000 V	
6	Current Input	1 A / 5A selectable from the front display	
	CT Burden	< 0.1 VA per phase	
	CT range	0.1% to 200%	
	Current over range	5A CT = 15A RMS continuous, 250A for 1 Sec 1A CT = 3A RMS continuous, 50A for 1 Sec	
	Range of Reading	0-60000 Amp	
	Primary Value of CT	Shall be programmable	
7	Power Factor	0.5 (lag) to 1.0 (unity) and 1.0 (unity) to 0.5 (lead)	
8	Accuracy kW / kWh	0.5 S as per IEC62053:22	
9	Real time & Average parameters	Required	
10	Four Quadrant measurement	Required	
11	LED Load Bar Indication	Optional	
12	Self-Diagnostic LED	Required	
13	Real time clock	Required	
14	Min./Max of parameters	Required	
15	THD	Required	
16	Individual Harmonics up to 39th	Required	
17	Real time waveform monitoring	Standard software to monitor real-time waveform	
18	Communication Port	Min 1 no. RS 485 port	

19	Isolation	Galvanic	
20	Communication protocols	MODBUS RTU, ASCII, selectable at site	
21	User defined registers	Optional	
22	Energy pulse LED for calibration test	Required	
23	Relay output	Optional	
24	Auxiliary Power Supply	Power Supply 24 V / 48V DC (24V & 48V as per site requirement)The MFM shall have in-built adequate protection against reversed polarity, over current and under voltage conditions, to prevent the internal logic from being damaged and becoming unstable causing mal-operation	
25	Environment	MFM will be installed on the Relay Panel in Control room with no temperature or humidity control. The MFM shall be capable of operating in ambient temperature from 0 to +65 degree C with rate of temperature change of 20 degree C/hour and relative humidity of 95%, non-condensing	
26	Mounting Panel cutout	92 mm x 92 mm, flush mounting	
27	Programming features	The meter should allow the user to configure the registers for the electrical parameters.	
		Unit should be fully programmable in the field and also remote configuration including PT/CT ratios and should have adequate protection for authorization for changes.	
28	Parameters to be monitored and reported:	Volt, Amp, Cos (Phi), kWatt, kvar, kVA, HZ, MWH Import & Export, MVARH Import & Export.	

Annexure- 7 (d)- Engineering Station (Laptop)

SL. NO.	TECHNICAL PARTICULARS	TPCODL REQUIREMENT	BIDDER RESPONSE
1	Make	Dell / HP / Lenovo / IBM	
2	Model		
3	Hardware	Laptop with latest Generation Processor, 64-bit, 1 TB SSD, 16 GB RAM, DVD RW, 4x USB Ports, 1x HDMI Port, 15" Display with 1 No. serial to USB converter, Min 1x Ethernet port in-built.	
4	Software	Microsoft Windows & Office License Latest Version	
		Antivirus software Minimum subscription of 3 years	
		RTU Configuration Software	
		IEC61850 Configuration Tool	
		RTU/BCU/BCPU, Master Simulation & Protocol Analyzer Software	
5	Accessories	Wireless Mouse & Laptop Bag RTU Configuration cable, 2 Mtrs LAN cable for Ethernet port connection with IED or RTU, USB to Serial Cable preferably Moxa make	
6	Auxiliary Power Supply	230V AC with adapter	

Annexure-7 (e) Contact Multiplying Relay (Digital Inputs)

SL. NO.	TECHNICAL PARTICULARS	TPCODL REQUIREMENT	BIDDER RESPONSE
1	Make	OMRON / ABB / Sulzer / OEN / Paramount/Phoenix	
2	Model		
3	Type	CMR	
4	Contact Configuration	2 NO with LED Indicator + Free wheeling Diode	
5	Contact Material	Silver alloy	
6	Contact make and carry	5 Amps @ 24VDC / 48V DC	
7	Coil voltage	24VDC / 48V DC	
8	Contact Resistance	20 M ohms	
9	Die Electric Strength		
9.a	Between open contacts	500V RMS	
9.b	Between contact and coil	2500 VAC	
12	Insulation Resistance	200 M Ohms @ 500VDC	
13	Operate time at Nominal voltage	20 milli secs	
14	Release time at Nominal voltage	10 milli secs	
15	Ambient temperature	-40 deg C to + 55 deg C	
16	Life Expectancy		
16.a	Mechanical Operations	20 million DC Relay	
16.b	Electrical Operations	> 100,000 operations	
19	Coil Resistance at nominal voltage(DC)	30,000 ohms + 10% @ 20 C	
20	Type of contact multiplie	2NO with LED Indicator + Free wheeling	
21	Type of mounting	DIN RAIL MOUNTING WITH SOCKET	
22	Standard applicable	IEC 60255-5	
23	Other Accessories:	Necessary TB, Din rail channel and other accessories to mount in SIC/RTU/CRP Panel	

Annexure-7 (f) Interposing Relay (Digital Output)

SL. NO.	TECHNICAL PARTICULARS	TPCODL REQUIREMENT	BIDDER RESPONSE
1	Make	OMRON / ABB / Sulzer / OEN / Paramount/Phoenix	
2	Model		
3	Type	Magnetic Blow out	
4	Contact Configuration	2 NO with LED Indicator + Free wheeling	
5	Contact Material	AgNi	
6	Contact make and carry	30A for 3 sec. & 5A continuously at 660V	
7	Contact mechanism	Self-Reset	
8	Coil Voltage	24/48VDC	
9	Input impedance	more than 50 Kilo ohms	
10	Operating time	Less than 15 m secs (DC)	
11	Mechanical durability	100000 cycle	
12	Ambient Temperature	-40 deg C to + 55 deg C	
13	Type of Mounting	Din Rail Mounting	
14	Socket	S8LD SOCKET	
15	Standard applicable	IEC 60255-5	
16	Other Accessories:	Necessary TB, Din rail channel and other accessories to mount in SIC/RTU/CRP Panel	

Annexure- 7 (g) Surge Protection Device (SPD)

SL. NO.	TECHNICAL PARTICULARS	TPCODL REQUIREMENT	BIDDER RESPONSE
1	Make	Moxa/Phoenix/RTEK/Santelequip	
2	Model		
3	Type	SPD for Ethernet Port	
4	Nominal Voltage (Vdc)	24/48V	
5	C2 Nominal Discharge Current (8/20μs)	2.5kA	
6	C2 Total nominal Discharge Current (8/20μs)	10kA	
7	Voltage Protection Level	;@C2 (8/20μs) Up ≤190V (L-L); ≤500V (L-G)	
8		;@C3 (1KV/μs) Up ≤145V (L-L); ≤600V (L-G)	
9	Lightning Impulse Current (10/350μs)	1kA	
10	Nominal Current	800mA	
11	Insertion Loss	≤0.1dB	
12	Transmission Speed	1000Mbps	
13	Transmission Standards	10BaseT / 100BaseT / 1000BaseT / 1000BaseTX (CAT6) / PoE	
14	Test Standard	IEC 61643-21 / EN 50173-1 / ISO/IEC 11801-Am.1	
1	Make	Moxa/Phoenix/RTEK/Santelequip	
2	Model		
3	Type	Specification of SPD for Serial connector	
4	Nominal Voltage (Vdc)	24/48V	
5	Nominal Current	0.5A	
6	Lightning Impulse Current (10/350μs) per line	1kA	
7	Voltage Protection Level	L-L ≤55V (24V) ≤100V (48V)	
8		L-G ≤55V (24V) ≤100V (48V)	
9	Supported Protocol	RS-232,RS-422,RS-485 (2w/4w)	
10	Bandwith line-line	100 MHz	
11	Test Standard	DIN EN 61643-21 / IEC 61643-21	

Annexure – 8: Indicative Bill of Material for Proposed Substation Automation System

Information to Bidder:

Sl. No.	Information to Bidder
1	Bill of Quantity mentioned in the tables are indicative, this may vary to meet the functional or site requirement. It is the responsibility of the Bidder to include all Hardware, Software, Configuration tools and Services as per functional requirement specified in the RFP and as per the phases mentioned.
2	Bidder to refer Approved make and model of the equipment to be considered for this project. All bidder's own and bought out items shall be subject to Purchaser's prior approval. Lead Bidder to submit all the Purchase orders released to Sub-vendors for TPCODL Review and Records.
3	The bidder shall propose and design the solution considering all the functional requirement stated in the RFP and shall submit the overall System Architecture considering current and phase wise implementation for approval.
4	System shall be modular in such a way that it shall allow flexible configuration of the system, adding modules as and when required. The system shall facilitate a gradual growth of the system through phased implementation as the Power System Network operating requirements expand or change.
5	Bidder shall include license for applications as applicable. Bidder shall also consider the enterprise version of software as feasible to meet the required functionality and to reduce the overall cost.
6	All the offered system will be with Operating System and shall be of latest version at the time of delivery and phase wise commissioning
7	All Systems Application, OS and configuration tools shall be kept current with latest OS version, Application Software, Configuration tools as and when the new system will be implemented/added in a phased manner.
8	Hardware Configuration of all RTU and other system shall be identical except IP Schema and if any specific requirement of the site.
9	The RTU should be modular to enhance the capacity and expected communication response speed are achieved with distributed system and final architecture frozen during detailed engineering.
10	The offered solution shall meet all the Cyber Security Requirement as per the standards such as IEC62443, NERC_CIP, NISTR, ISO 27001 and NCIIPC guidelines. All the Cyber Security measures shall address Operational Technology requirement. Bidder shall ensure the proposed architecture at Substation are certified by CERT-IN Certified Third Party Cyber Security auditor for the compliance as per Industry standards. Bidder to demonstrate all the cyber security measures considered and implemented during FAT and SAT. Bidder to ensure that all the product own and sub-vendor product offered are tested at CPRI Lab for cyber security as per the Guidelines of MoP Order No.25-L7 /6/2018-PG dated 2nd July, 2020

Sl. No.	Information to Bidder
11	The proposed system will be integrated with other external systems and the required interfaces shall be considered accordingly. Since all external systems are different, special studies for interfaces shall be conducted for seamless integration.
12	The platform services shall be common to the whole family of products; thus, integrated control of power system network is possible from one base platform. Allows data to be distributed across a number of sites and systems.
13	The bid shall include Unified data engineering environment for data take-on and data maintenance, facilitating a single point of entry for both data configuration and use for multiple application/calculation and data management.
14	Bidder to indicate clearly the no. of Software licenses (proprietary & third party) included taking into account no. of RTUs, Communication Equipment, Controller, redundant equipment, I/O Tags etc. Bidder shall also indicate the (slab-wise) incremental price for each of these licenses as applicable. It will be deemed to be nil if not indicated separately. Bidder shall consider enterprise license for common applications for proposed system.
15	Each selected application shall include necessary prerequisites, if any.
16	All cabling (Communication, Power Supply, Field, Interfaces) is in Bidder's scope. This includes supply, laying, termination and connection to equipment.
17	All Networking accessories and all types of Cables required for integration of other systems shall be considered by the bidder.
18	Necessary Communication equipment (Industrial grade) such as Layer2 switches, Router, Networking cables, patch cords etc. for integrating the Substation Automation System with Purchaser's SCADA System through NBSP Communication network shall be in the scope of the Bidder. All structure cabling at Sub-Stations (if any) is in Bidder scope. All the Communication equipment shall be DC Powered.
19	Bidder to ensure the deployment of the resources and service requirement during Warranty Support for all the supplied equipment (Bidder's Own and bought out items). SLA will be prepared with the successful bidder to achieve the 24X7 availability and reliability of the installed system
20	It is the responsibility of the bidder to provide Patch Management, Software upgradation, Firmware Upgradation for Bidder's Owned items, Sub-vendor items, Communication and Networking items during Warranty period as per the SLA.
21	Purchaser may procure any item from elsewhere. Integration of those with supplied system is in Bidder's scope.
22	All annual maintenance charges of supplied Hardware, OS & Software are inclusive in the Warranty of Bidder's Owned items, Sub-vendor items, Communication and Networking items, software licenses their renewal, upgrades etc. Please note standard 5 Years warranty shall be included with the offered price of the solution and there will be no separate item for standard warranty.
23	All the materials to be delivered should be F.O.R at TPCODL sites.
24	The bidders are advised to quote prices strictly in the format attached.

Sl. No.	Information to Bidder
25	The bidder must fill each column of the format attached. Mentioning “extra/inclusive” in any of the column may lead for rejection of the price bid.
26	No cutting/ overwriting in the prices is permissible.
27	The unit price to be indicated in col. No. 8 should be exclusive of taxes & duties which are to be indicated in separate columns meant for the purpose.
28	The bids will be evaluated commercially on the overall all-inclusive lowest cost lowest for the individual LOT as defined in the tender BOQ as calculated in Schedule of Items TPCODL however, reserves right to split the order line item wise and/or quantity wise among more than one Bidder. Hence, all bidders are advised to quote their most competitive rates against each line item.
29	In case of increase in quantity for any item, the unit rate mentioned above shall be considered for the same.
30	HSN/SAC codes for respective line item must be mandatorily provided wherever applicable.
31	TPCODL reserve the right to split the order quantity to any extent amongst the bidders.