ANNEXURE - II

TPSODL

Specifications for Automation Equipment and Kiosk

CONTENTS

ANNEXURE - II

Specifications for Automation Equipment and Kiosk

1.0	Scope	TPSODL has commissioned SCADA with Master Control Center and Back-up Control Centre through which 259 PSS are going to be controlled and monitored. TPSODL envisages adding the new grids and renovation of existing PSS to make them SCADA enabled. The station level automation should enable to communicate with both the stations simultaneously. The Substation Automation shall be structured in three levels – Station Level (RTU/DCU), Bay Level (IEDs) and Process Level (CT, PT and other devices). The RTU/DCU, IEDs at both Station Bus level & Process level and Network Switches should be accessible for engineering activities from a remote location by using TPSODL's network. The scope of this specification covers all the Technical Requirements of Design, Engineering, Manufacture, Testing at manufacturer's works, packing, forwarding, supply and unloading at site/stores complete with all accessories including installation, testing and commissioning of efficient and trouble free Remote Terminal Unit / Data Concentrator Unit, Network Switches and Communication accessories including all works required for successful integration with all IED's, Meters etc. on Station Bus and Process Bus level & with Master SCADA. The scope of this specification also covers the Automation requirement for Control and Relay Panels, IEDs, Aux. Relays, Network Switches and all other items required for SCADA control & protection of 33kV/11kV power system. The RTU supply & Services is segregated as follows: **PART-A:** **RTU Type-A:** This type of RTU with redundancy as specified shall be supplied, installed and commissioned at Urban sub-stations as required by purchaser. **RTU Type-B:** This type of RTU without redundancy as specified shall be supplied, installed and commissioned at required Rural sub-stations as required by purchaser. Services required: 1. Bidder shall undertake shifting of supplied material from location of unloading to the allocated location for installation. 2. Erection and installation of supplied panels including all peripheral activities of fixing, welding etc. 3. Required auxiliary AC/DC power cable, supply as well as laying from ACDB/DCDB inside control room (of max 20m x 20m area) to RTU panel, Cable to be laid in the cable trays provided to C&R panel inside control

		room with cabling, termination and wiring including proper dressing of wiring. 4. Testing and commissioning of RTU panel with complete cable terminations. Blocking of all the cable openings on the bottom plate of panel for rodent and vermin proofing to be ensured. 5. Required ethernet cable (CAT-6) supply as well as laying from C&R panels to ethernet switches to RTU panel. Max no of panels will be 15 numbers. Cable (Double Run) for networking to be laid from C&R panels till Ethernet Switch in Flexible GI Conduit. Loop cables among Ethernet switches installed in C&R panels and the Ethernet Switches installed in RTU Panel also to be laid in GI Flexible Conduit till RTU panel. 6. Required serial cable supply as well as laying from C&R panels to RTU panel for serial devices. Max no of panels will be 15 numbers. Cable (Double Run) for networking from C&R panels till RTU Panel to be laid in GI Flexible Conduit. 7. Earthing to be extended from RTU panel to the station earthing pit by the bidder. 8. Point to point as well as configuration logic testing from equipment end terminals to CRP end terminals is in the bidder's scope. 9. All connectivity and integration services for Relays/MFM/ any other available devices to RTU as well as integration with existing GE SCADA is in bidder's scope. 10. Submission of detailed test report after successful completion of the respective Sub Station job and obtain clearance from TPSODL authority. 11. Any Miscellaneous activities required for commissioning and SCADA integration is in bidder's scope. **PART-B:** **Supply & Services:** Bidder has to supply and install RTU (Type-A) in the existing RTU panel by replacing existing RTU. Decommissioning and removal of existing RTU is in bidder's scope. All existing wiring and connections shall be maintained and shall be made workable after installation of supplied RTU. Testing, commissioning and integration of RTU with existing IEDs/ MFM / and all available devices in the substation as well as integration with existing GE SCADA is in bidder's scope. This specification will be applicable for existing PSS/existing Bays/ Renovated PSS. The project is proposed to be implemented as per the scope mentioned for **33/11 kV Primary Sub-Stations in FY'22-23 & FY'23-24.**

ANNEXURE - II

Specifications for Automation Equipment and Kiosk

<table>
<tr><td></td><td></td><td>The specific requirements are covered in the technical specs & data sheet.</td></tr>
<tr><td>2.0</td><td>Applicable Standards</td><td>The equipment covered by this specification shall unless otherwise stated, be designed, constructed and tested in accordance with latest revisions of relevant Indian/IEC/other applicable standards shall confirm to the regulations of local statutory authorities.

• IEC 60870-5-104
• IEC 61850 (All Parts)
• IEC 62439-3 (PRP)
• IEC 61131-3
• IEC 62056
• IEC 61588/IEEE 1588v2
• IEC 62351</td></tr>
<tr><td>3.0</td><td>Climatic Conditions of the Installation</td><td>The atmosphere is generally humid and dust suspended during dry months and subjected to fog in cold months. The design of the equipment and accessories shall be suitable to withstand seismic forces corresponding to an acceleration of 0.1g.

<table>
<tr><td>Max. Ambient Temperature</td><td>55°C</td></tr>
<tr><td>Max. Daily Average Ambient Temperature</td><td>35°C</td></tr>
<tr><td>Min. Ambient Temperature</td><td>10°C</td></tr>
<tr><td>Max. Humidity</td><td>100%</td></tr>
<tr><td>Min. Humidity</td><td>30%</td></tr>
<tr><td>Average No. of Thunderstorm days per annum</td><td>100 Days</td></tr>
<tr><td>Average Annual Rainfall</td><td>2000 mm</td></tr>
<tr><td>Average No. of Rainy days per annum</td><td>87</td></tr>
<tr><td>Rainy months</td><td>June to September</td></tr>
<tr><td>Altitude above MSL not exceeding</td><td>1000 m</td></tr>
<tr><td>Highest Wind speed</td><td>160 KM/Hr.</td></tr>
</table>
</td></tr>
<tr><td>4.0</td><td colspan="2">General Technical Requirements</td></tr>
<tr><td>4.1</td><td>General Requirements from the Business Associates</td><td>• The supplier should have at least 10 years of experience in design and supply of control and automation systems for electricity transmission and distribution applications.
• Bidder shall provide details of projects with application modules, which have been successfully completed during the last 5 financial years as per the format below. 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</td></tr>
</table>

<table>
<tr>
<td></td>
<td></td>
<td>format in the table provided and necessary supporting documents should be attached with RFP:

<table>
<tr><th>Sl. No.</th><th>Name of the Project</th><th>Client Name and Contact Details</th><th>Whether the Project was successfully commissioned</th><th>Date and Year of Commissioning</th><th>Value of the Project</th><th>Indicate the RTU with modules implemented in the project</th><th>Indicate the integration with SCADA System</th><th>Indicate Whether interface was included in the project? If Yes, please Provide the details</th></tr>
</table>

• The manufacturer, whose substation automation and protection system is offered, should have designed, manufactured, tested, installed and commissioned such a system for electricity transmission and distribution for at least 10 projects.
• The manufacturer needs to submit the proof of completing such tasks with other utilities/concerns as its experience certificate.
• The SCADA system should be integrated with Numerical Relays on standard international protocols.
• The Business Associate can offer an innovative and advanced system and the ways and cost to integrate the same in the existing infrastructure. The offer is subjected to an approval from TPSODL after a thorough discussion between the BA and TPSODL. In case, an approval is not awarded to the BA's offered innovative system, TPSODL's existing/desired infrastructure prevails and the BA shall provide the system accordingly.
• The BA should optimize on the cost of software products offered to TPSODL considering already available licenses with TPSODL. The BA should clearly indicate licensing policy for the software tools offered.
• The BA should provide necessary training to the personnel recommended by TPSODL to maintain the system and troubleshooting reports.</td>
</tr>
<tr>
<td>4.2</td>
<td>General System Design</td>
<td>The Substation Automation System (SAS) shall be suitable for operation and monitoring of the complete substation including future extensions and shall</td>
</tr>
</table>

		works on IEC 61850 Edition-2. The offered system shall be compliant to IEC 61850 Edition-2 with backward compatibility to Edition-1. The systems shall be of the state-of-the art suitable for operation under electrical environment present in high voltage substations (33/11kV), follow the latest engineering practice, and ensure long-term compatibility requirements and continuity of equipment supply and the safety of the operating staff. The offered SAS shall support remote control and monitoring from Remote Control centers (MCC/BCC) via gateways. The system shall be designed such that personnel without any background knowledge in Microprocessor-based technology are able to operate the system. The operator interface shall be intuitive such that operating personnel shall be able to operate the system easily after having received some basic training. The system shall incorporate the control, monitoring and protection functions specified, self-monitoring, signaling and testing facilities, measuring as well as memory functions, event recording and evaluation of disturbance records. Maintenance, modification or extension of components may not cause a shutdown of the whole substation automation system. Self-monitoring of components, modules and communication shall be incorporated to increase the availability and the reliability of the equipment and minimize maintenance. All IEDs must have conformal coating for protection against harsh environments.
4.3	**System Architecture**	The SAS shall be based on a decentralized architecture and on a concept of bay-oriented, distributed intelligence. Functions shall be decentralized, object-oriented and located as close as possible to the process. The main process information of the station shall be stored in distributed databases. The typical SAS architecture shall be structured in three levels, i.e. Process Level, Bay Level and Station Level in a station and a bay level. ***The Process Level*** takes care of the data acquisition using instrument transformers. The output of these instrument transformers are sampled, converted to digital representation, and formatted for subsequent transmission through the Process Bus Local Area Network (LAN). The Process Bus is also used

		to control high voltage switchgear equipment such as breakers, breaker control units, disconnector switches, etc. Process level information is then communicated over the LAN to the protection and control devices that are located in the Bay/Unit Level as per IEC 61850-9-2. The BCPU/Relay Units and MFM are the interface to conventional current/voltage transformers, switchgear. IEC 61850 Process Bus standard defines the Specific Communication Service Mapping (SCSM) for the transmission of Sampled Values. **IEC 61850-9-2** defines a bidirectional user configurable dataset that can be configured using the Substation Configuration Language and multicast to multiple subscribers. **The IEC 61850-9-2LE** defines a base sample rate of **80 samples per cycle for basic protection and control applications**, and a sample rate of **256 samples per cycle for high frequency applications, such as power quality monitoring and high resolution oscillography**. For 50 Hz systems, this translates to 4 kHz and 12.8 kHz sampling frequencies respectively. ***At Bay Level***, the IEDs shall provide all bay level functions regarding control, monitoring and protection, inputs for status indication and outputs for commands. The Bay Level IEDs should be directly connected to the switchgear without any need for additional interposition or transducers. The Ethernet switch must be IEC 61850 compliance. The Speed of the Ethernet switch should be 1Gpbs for Process Bus and 10/100Mbps for Station Bus. ***At Station Level,*** the entire station shall be controlled and supervised from the station Remote Terminal Unit/Data Concentrator Unit. It shall also be possible to control and monitor the bay from the bay level equipment at all times. Clear control priorities shall prevent operation of a single switch at the same time from more than one of the various control levels, i.e. MCC/BCC, RTU/DCU, bay level or apparatus level. The priority shall always be on the lowest enabled control level. The station level contains the station-oriented functions, which cannot be realized at bay level, e.g. alarm list or event list related to the entire substation, gateway for the communication with remote control centers. Integration & testing of remote end LDR with RTU shall be in Scope of Bidder including the However, TPSODL shall provide necessary integration support at

		RTU end. System architecture shall be submitted by bidder for review & approval by TPSODL.
4.4	**Functional Requirements**	The high-voltage apparatus within the station shall be operated from different places: • Remote control centers (MCC/BCC) • RTU/DCU • BCPUs/Main Protection Units (in the bays). • IEDs such as DCMU/Fire alarm panel/ temperature & humidity sensors Operation shall be possible by only one operator at a time. The operation shall depend on the conditions of other functions, such as interlocking, synch-check, etc. **Select-Before-Execute:** For security reasons the command is always to be given in two stages: selection of the object and command for operation under all mode of operation except emergency operation. Final execution shall take place only when selection and command are actuated. **Command Time-Out:** Command execution timer (configurable) must be available for each control level connection. If the control action is not completed within a specified time, the command should get cancelled and an alarm shall be generated to indicate the failure of command.
4.5	**Communication Interface**	The RTU / Data concentrator shall have the capability to support simultaneous communications with multiple independent remote master stations (8 nos. minimum). It would have 2 nos. of physical ports and each port would have the capability of communicating to minimum of 8 nos. of SCADA masters simultaneously. The communication interface to the SAS shall allow scanning and control of defined points within the substation automation system independently for each control centre. The substation automation system shall simultaneously respond to independent scans and commands from TPSODL's control centres (MCC & BCC). The substation automation system shall support the use of a different communication data exchange rate (bits per second), scanning cycle, and/or communication protocol to each remote control centre.

		Also, each control centre's data scan and control commands may be different for different data points within the substation automation system's database
4.6	**Communication Protocol**	The communication protocol for gateway to control centre must be open protocol and shall support IEC 60870-5-104 and IEC 61850/ IEC-103 for all levels of communication for sub-station automation. IEC 61850 (ED1 & ED2), IEC 60870-5-104, IEC 60870-5-103, MODBUS (Serial and TCP/IP) shall be supported. The RTU shall meet the IEC 61850 standard in every respect and interoperability with other manufactures IEDs and tools shall be verified. In addition, the RTU / Data Concentrator is expected to have serial ports RS 485 for communication to auxiliary devices such as MFMs, Meters, NIDSs, DCDBs, APFCs and other IEDs Data Concentrator to Remote Control Centers (MCC/BCC): IEC 60870-5-104 Data Concentrator to BPCUs/LDR/TDR/Relays: IEC 61850-8-1/ IEC60870-5-103 Data Concentrator to Meters: Modbus TCP/IP / RTU / IEC62056 Data Concentrator to MFMs/DCDB/NIDS/APFC/Solar Logger: Modbus TCP/IP / RTU Data Concentrator to other IEDs such as battery charger DC monitoring unit (DCMU)/ Transformer monitoring unit (TMU), Temperature and Humidity sensor: Modbus TCP/IP / RTU Between BCPUs/LDRs/TDRs/Relays and TMU: IEC 61850-8-1 *Converters (protocol/media/power supply) of any sort will not be permitted.
4.7	**Time Synchronization**	The RTU/DCU will get time synchronization signal from the Front End Processor (FEP) Servers over SNTP over IEC 60870-5-104 with CP56 time format. Further RTU/DCU shall act as SNTP Server for IEDs at Bay Level. Time synchronization signal would be available to the Data Concentrator at regular specified intervals and is independent of the station computers and gateways. The RTU/DCU in turn should synchronize all devices via inter bay bus using SNTP as defined in IEC 61850 standard.
4.8	**Response Time and IO Capabilities**	The total I/O count in a major substation will become large and it must be ensured that the hardware and communication links have sufficient performance to ensure prompt processing of incoming data. Overload in this area can lead to one or more of the following:

		▪ undue delay in updating the system status diagrams/events log/alarm log in response to an incident ▪ corruption of system database, so that the information presented to the operator is not an accurate representation of the state of the actual electrical system ▪ system lockup As I/O at the bay level, both digital and analogue will typically be handled by intelligent relays or specialized IED's, it is therefore important to ensure that these devices have sufficient I/O capacity. If additional IED's have to be provided solely for ensuring adequate I/O capacity, cost and space requirements will increase. There will also be an increase in the number of communication links required. **Input / Output Requirement** a. High disturbance immunity, meeting the requirements of the IEC directives 89/336/EEC and 73/23/EEC when placed in cabinets. b. Comprehensive self-diagnostics c. On-board processing capabilities such as time-tagging, event handling, filtering and gain control. d. Reliability and Auto-Diagnostics e. Easy to configure f. Quick fault finding with help of LEDs of each module and channel g. The relative time error between events (DI signals) handled within the RTU shall be ≤1 ms (interrupt driven). The RTU/Data concentrator should have the capability of expansion for I/O.
4.9	**Errors in Communication**	A significant problem to be overcome in the implementation of communication links is the possibility of electromagnetic interference. The low voltage levels that are used on most types of communication link may be prone to interference as a result. Careful design of the interfaces between the devices used and the communication bus, involving the use of opto-couplers is required to minimize the risk. Care over the arrangement of the communication cables is also required. It may also help to use a communication protocol that incorporates a means of error detection/correction. While it may not be possible to correct all errors, detection offers the opportunity to request re-transmission of the message, and also for statistics to be gathered on error rates on various parts of the system. An unusually high error rate on a part of the communication system

		can be flagged to maintenance crews for investigation. Error detail should be available/ archived in RTU/DC log/Archive, Archiving limit should be min 1000.
4.10	**Remote Terminal Unit (RTU) OR Data Concentrator (DC) – Type A**	In general, the RTU/DC design should aim to minimize power consumption and heat generation. It should be designed to work in an electrical installation by being of robust physical construction with immunity to electrical noise. The RTU/Data Concentrator shall be assembled from modular units, for example, power supply module, CPU and communications module, communication interface modules and modules for input/output purposes. I/O and serial cards shall be able to be arranged in the RTU rack in any order. The data concentrator shall be a product manufactured using industrial grade components and should be based on microprocessor technology and shall use numerical techniques for the calculation and evaluation of externally input analog and digital signals. Should provide following functionalities: 1. CPU should be of 32-bit Processor @ 350MHz Speed at least. 2. The Flash Memory should not be less than 2GB 3. There should not be more than 16 IEDs per Ethernet Port and 8 IEDs per Serial Port. 4. 4 Ethernet ports and min 2 Serial RS485 ports 5. It should have enough RS485 ports to communicate with all Modbus devices taking into consideration that each Modbus loop will not have more than 8 devices. 6. Serial port shall support IEC 60870-5-103 and Modbus RTU protocol. 7. Serial RS485 port shall support different OEM devices on IEC60870-5-103 and Modbus RTU protocol. 8. In addition to above, Bidder shall provide Industrial Grade Serial Server of 4 RS485 ports with two Ethernet copper port as an optional item. This server shall communicate with RTU on IEC61850/IEC104/Modbus TCP protocol. 9. Separate maintenance port shall be provided with RTU. Suitable adaptor or converter shall be provided to communicate with Engineering Laptop on Ethernet port.

		10. Speed of Ethernet port will be 10/100 MBPS and Baud rate of serial from 300-57600 bits/sec user configurable 11. I/O requirement: 32 DI, 8 DO, 8 AI 12. All the cards/modules of the RTU/DC must have conformal coating for protection against harsh environments. 13. Bidder shall consider Dual Input Source for energizing the RTU along with Diode-oring unit. 14. 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. 15. Reverse polarity protection shall be provided. 16. The RTU Panel hardware installed shall comply to IP54 or better enclosure. 17. The RTU/Data Concentrator should be designed to handle minimum 5000 data points. 18. The RTU/ Data Concentrator should support min. of 4 SNTP Servers and broadcast the time sync to the IEDs at Bay level 19. The RTU/Data Concentrator should support IEC 61850, IEC 60870-5-101, IEC 60870-5-103, IEC 60870-5-104, Modbus RTU, Modbus TCP/IP, DNP3.0 Serial and DNP3.0 TCP/IP (Configuration will be based on requirement at PSS) 20. There should be a provision to simulate the I/Os from the RTU 21. There should be option to download (RTU to Laptop) the existing configuration from the RTU/Data Concentrator 22. Provide a communication facility to the IEDs & Auxiliary Devices through Network Communication and/or Serial communication over RS485 23. Data concentrator should support all the Data Types i.e, all Type Identifiers as specified in IEC 60870-5-104 for remote communication.

		24. Should have an ability to collect data from all connected devices, regardless of protocol and make it available to the control centers & HMI using a LAN/WAN connectivity. 25. Should act as a protocol translator to ensure interoperability with the protocols defined in the communication principle section. 26. Should communicate to minimum 8 masters simultaneously on IEC 60870-5-104 protocol on a same CASDU 27. Should be compatible to integrate IEDs on both IEC 61850 Ed.1 and Ed.2 28. Should be capable of handling real time data exchange services to publish or subscribe information for defined master and slave protocols. 29. Web Server Functionality that makes substation information available to authorized users. 30. Substation Information Manager to manage important substation information and events 31. Should provide of Hardware diagnostics, System initialization, Watchdog management functions 32. Should provide for time & millisecond synchronization function. 33. Provide for pass through access for remote maintenance of the automation devices connected 34. Should provide latest Microsoft Windows based maintenance and configuration tools. The tools should have functionality of both remote and local access. 35. Minimum functionalities to be provided through these tools are device configuration, security settings, log files, communication traces and system statistics. 36. Software, configuration tools and firmware updates/releases must be upgraded at free of cost for next 5 years after commissioning of the data concentrator (supplier should inform us for any updates in advance)

		37. It should have complete hardware design including CPU, Power Supply, Communication Modules and Bus Interface Unit/Card. 38. It should have enough RS485 ports to communicate with all Modbus devices taking into consideration that each Modbus loop will not have more than 8 devices. 39. Data Concentrator should support IEC 61131-3 with necessary license. 40. Data concentrator should have following the cyber security features 41. Access Management 42. System Audit Logs 43. Events Management 44. System Hardening 45. Secured connection via SSH/SFTP/SCP/HTTPS/TLS 46. Should support SNMP v1.0/2.0/3.0 (as Client and server both) feature. 47. Auxiliary power supply for the RTU/DC should have in the range of 24VDC or 48VDC depends upon Station DC Supply with tolerance of ±15%. 48. The processor shall monitor the health of the RTU with built in diagnostics, which are capable of remote interrogation including diagnostics for memory and bus errors, buffer overflows, local software routine health, communication ports status, input/output card health. Diagnostics shall also be supplied that shall permit complete testing of the RTU with a portable computer. Diagnostic checking of the communication ports shall be provided to permit checking by a portable computer. 49. The RTU shall possess memory to permit storage of a minimum of 2000 events (input changes) locally for subsequent transmission to the SCADA master station. A separate buffer shall be preferable for digital and analogue events. 50. The RTU shall have a real time clock, with a resolution of 1ms. It shall have the capability of time stamping events. The RTU clock is normally

		synchronized by the SCADA/DMS FEPs. In the advent that this does not occur, the RTU clock shall drift no more than 1 second in 24 hours. 51. Provisioning of RF receiver module or 3G/4G network module in RTU so that RTU shall integrate with FRTU/or other IEDs over RF or 3G/4G interface also. 52. PC based Gateway Solution is strictly not acceptable. 53. It shall be possible to increase the number of hardware inputs & outputs by addition of I/O Modules 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. 54. The RTU shall reset the analog value of a MFM to zero when communication with the MFM fails. 55. RTU should report to Control Centre in case of any communication failure with devices in the substation instantaneously. 56. The proposed RTU and the relays and MFM as per revised scope mentioned in this corrigendum shall be integrated with existing GE SCADA system at TPSODL. 57. 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. 58. The RTU shall be redundant in hot standby mode with bump less Auto Changeover. 59. 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. 60. In case of power supply failure, auto start-up and restoration of the RTU shall be possible without manual intervention.

		61. Internal battery backup to hold data in SOE buffer with time & date in case of failure of supply. 62. The proposed RTU shall be KEMA Certified or by equivalent certification body like NABL /CPRI/International Accredited Lab. 63. Separate set of communication modules shall be used for communicating to slave IEDs and to Purchaser's FEP/Master Systems.
4.10	**Remote Terminal Unit (RTU) OR Data Concentrator (DC) without redundancy – Type B**	In general, the RTU/DC design should aim to minimize power consumption and heat generation. It should be designed to work in an electrical installation by being of robust physical construction with immunity to electrical noise. The RTU/Data Concentrator shall be assembled from modular units, for example, power supply module, CPU and communications module, communication interface modules and modules for input/output purposes. I/O and serial cards shall be able to be arranged in the RTU rack in any order. The data concentrator shall be a product manufactured using industrial grade components and should be based on microprocessor technology and shall use numerical techniques for the calculation and evaluation of externally input analog and digital signals. Should provide following functionalities: 1. CPU should be of 32-bit Processor @ 350MHz Speed at least. 2. The Flash Memory should not be less than 2GB 3. There should not be more than 16 IEDs per Ethernet Port and 8 IEDs per Serial Port. 4. 2 Ethernet ports and required min 2 Serial RS485 ports 5. It should have enough RS485 ports to communicate with all Modbus devices taking into consideration that each Modbus loop will not have more than 8 devices. 6. Serial port shall support IEC 60870-5-103 and Modbus RTU protocol. 7. Serial RS485 port shall support different OEM devices on IEC60870-5-103 and Modbus RTU protocol.

		8. In addition to above, Bidder shall provide Industrial Grade Serial Server of 4 RS485 ports with two Ethernet copper port as an optional item. This server shall communicate with RTU on IEC61850/IEC104/Modbus TCP protocol. 9. Separate maintenance port shall be provided with RTU. Suitable adaptor or converter shall be provided to communicate with Engineering Laptop on Ethernet port. 10. Speed of Ethernet port will be 10/100 MBPS and Baud rate of serial from 300-57600 bits/sec user configurable 11. I/O requirement: 32 DI, 8 DO, 8 AI 12. All the cards/modules of the RTU/DC must have conformal coating for protection against harsh environments. 13. Bidder shall consider Dual Input Source for energizing the RTU along with Diode-oring unit. 14. 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. 15. Reverse polarity protection shall be provided. 16. The RTU Panel hardware installed shall comply to IP54 or better enclosure. 17. The RTU/Data Concentrator should be designed to handle minimum 5000 data points. 18. The RTU/ Data Concentrator should support min. of 4 SNTP Servers and broadcast the time sync to the IEDs at Bay level 19. The RTU/Data Concentrator should support IEC 61850, IEC 60870-5-101, IEC 60870-5-103, IEC 60870-5-104, Modbus RTU, Modbus TCP/IP, DNP3.0 Serial and DNP3.0 TCP/IP (Configuration will be based on requirement at PSS) 20. There should be a provision to simulate the I/Os from the RTU 21. There should be option to download (RTU to Laptop) the existing configuration from the RTU/Data Concentrator

		22. Provide a communication facility to the IEDs & Auxiliary Devices through Network Communication and/or Serial communication over RS485 23. Data concentrator should support all the Data Types i.e, all Type Identifiers as specified in IEC 60870-5-104 for remote communication. 24. Should have an ability to collect data from all connected devices, regardless of protocol and make it available to the control centers & HMI using a LAN/WAN connectivity. 25. Should act as a protocol translator to ensure interoperability with the protocols defined in the communication principle section. 26. Should communicate to minimum 8 masters simultaneously on IEC 60870-5-104 protocol on a same CASDU 27. Should be compatible to integrate IEDs on both IEC 61850 Ed.1 and Ed.2 28. Should be capable of handling real time data exchange services to publish or subscribe information for defined master and slave protocols. 29. Web Server Functionality that makes substation information available to authorized users. 30. Substation Information Manager to manage important substation information and events 31. Should provide of Hardware diagnostics, System initialization, Watchdog management functions 32. Should provide for time & millisecond synchronization function. 33. Provide for pass through access for remote maintenance of the automation devices connected 34. Should provide latest Microsoft Windows based maintenance and configuration tools. The tools should have functionality of both remote and local access.

		35. Minimum functionalities to be provided through these tools are device configuration, security settings, log files, communication traces and system statistics. 36. Software, configuration tools and firmware updates/releases must be upgraded at free of cost for next 5 years after commissioning of the data concentrator (supplier should inform us for any updates in advance) 37. It should have hardware design including CPU, Power Supply, Communication Modules and Bus Interface Unit/Card. 38. It should have enough RS485 ports to communicate with all Modbus devices taking into consideration that each Modbus loop will not have more than 8 devices. 39. Data Concentrator should support IEC 61131-3 with necessary license. 40. Data concentrator should have following the cyber security features 41. Access Management 42. System Audit Logs 43. Events Management 44. System Hardening 45. Secured connection via SSH/SFTP/SCP/HTTPS/TLS 46. Should support SNMP v1.0/2.0/3.0 (as Client and server both) feature. 47. Auxiliary power supply for the RTU/DC should have in the range of 24VDC or 48VDC depends upon Station DC Supply with tolerance of ±15%. 48. The processor shall monitor the health of the RTU with built in diagnostics, which are capable of remote interrogation including diagnostics for memory and bus errors, buffer overflows, local software routine health, communication ports status, input/output card health. Diagnostics shall also be supplied that shall permit complete testing of the RTU with a portable computer. Diagnostic checking of the communication ports shall be provided to permit checking by a portable computer.

		49. The RTU shall possess memory to permit storage of a minimum of 2000 events (input changes) locally for subsequent transmission to the SCADA master station. A separate buffer shall be preferable for digital and analogue events. 50. The RTU shall have a real time clock, with a resolution of 1ms. It shall have the capability of time stamping events. The RTU clock is normally synchronized by the SCADA/DMS FEPs. In the advent that this does not occur, the RTU clock shall drift no more than 1 second in 24 hours. 51. Provisioning of RF receiver module or 3G/4G network module in RTU so that RTU shall integrate with FRTU/or other IEDs over RF or 3G/4G interface also. 52. PC based Gateway Solution is strictly not acceptable. 53. It shall be possible to increase the number of hardware inputs & outputs by addition of I/O Modules 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. 54. The RTU shall reset the analog value of MFM to zero when communication with the MFM fails. 55. RTU should report to Control Centre in case of any communication failure with devices in the substation instantaneously. 56. The proposed RTU and the relays and MFM shall be integrated with existing GE SCADA system at TPSODL. 57. 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. 58. In case of power supply failure, auto start-up and restoration of the RTU shall be possible without manual intervention. 59. Internal battery backup to hold data in SOE buffer with time & date in case of failure of supply.

<table>
<tr><td></td><td></td><td>60. The proposed RTU shall be KEMA Certified or by equivalent certification body like NABL /CPRI/International Accredited Lab.</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>4.11</td><td>TPSODL approved Make and Models for RTU/DC</td><td>
<table>
<tr><th>S. No.</th><th>Make</th><th>Model</th></tr>
<tr><td>1</td><td>Hitachi Energy Ltd.</td><td rowspan="5">Latest user-friendly model complying above specifications.</td></tr>
<tr><td>2</td><td>GE T&D Ltd.</td></tr>
<tr><td>3</td><td>Siemens Ltd.</td></tr>
<tr><td>4</td><td>Schneider Electric</td></tr>
<tr><td>5</td><td>Reputed make (Subject to purchaser’s approval)</td></tr>
</table>
</td></tr>
<tr><td>4.12</td><td>RTU/IED Simulator & Protocol Analyzer software tool</td><td>a. RTU simulator tool shall be provided to test the communication interfaces of Master station, 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 Master, IEC 60870-5-103 Master, Modbus RTU & TCP Master & IEC61850 Client. 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 and between 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 with following features:

o Each received message shall be checked for validity, including the check sum.
o The tool shall maintain and display error counters so that the number of errors during a period of unattended testing can be determined.
o All fields of a message shall be displayed. A pass/fail indication for the message shall be included.</td></tr>
<tr><td>4.13</td><td>Ethernet Switch</td><td>The 61850 compliance Managed Ethernet Switch shall meet the demands of power system automation systems Auxiliary Power Supply: 24VDC or 48VDC (depending upon the Station DC Voltage) with ±15% tolerance, Dual Power Supply</td></tr>
</table>

		a. Separate MCB with appropriate rating shall be used to power up the Switch b. Operating Temperature: -5° to +85°C. c. 19" Rack Mountable with Power Socket and Ports at rear side d. Compliance to IEC 61850-3, IEEE 1613 Standards e. Port Speed: 10Mbps/100Mbps for Station Bus and 1Gbps for Process Buss f. Should support PTP g. Each switch should have 24 copper Ports h. LED indicators for link establishment and data transfer for each port i. Should support remote user setting configuration. j. Warranty for the switch must be 5 years. k. It should own separate maintenance/console port l. Latency shall not be more than 10 micro sec. m. Should support SNMP Server v1.0/v2.0/v3.0 n. Should be KEMA Certified or equivalent o. All the cards/modules of the Switch must have conformal coating for protection against harsh environments. p. 18-72 V DC power supply module, with ±20% tolerance q. Separate MCB with appropriate rating shall be used to power up the Switch **Approved makes: 1. Ruggedcom, 2. Hirschmann, 3. Siemens 4. MOXA** **5. Reputed make (subject to purchaser's approval)**
4.14	**Serial Server**	Industrial grade Serial Server shall be used to communicate with additional numbers of serial devices with RTU. Serial Server shall have 4 Nos. RS485 serial ports and 2 Nos. Ethernet port. It should be designed to operate in harsh environment. It should have an integrated power supply with a wide range of auxiliary voltages 18V -72V DC. An operating temperature range of -40 to 85 °C (-40 to 185 °F) without the use of internal cooling fans allows it to be placed in almost any location.
4.15	**GPRS Modem**	Communication between RTU and Control Centre SCADA/ADMS will be established either through GPRS Modem or 2 MBPS MPLS Link. 2 MBPS MPLS RF communication link shall be in the scope of the purchaser. SITC of 5G/4G GPRS modem will be in the scope of the Bidder, however, SIM and subscription charges will be arranged by the

		purchaser.
4.16	**Cybersecurity**	a. Secure access Level Wise enabling of settings with User Rights should be incorporated with Password protection in the RTU. Each User shall have his/her own User Id & Passwords. 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 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 viz. Role based access control & password complexity e. The RTU should also supports Authentication and Authorization of individual users, Security logging. f. RTU shall be NERC-CIP/NIST 7628, IEC62351, IEC 62443 and IEEE 1686 compliant. g. In addition to above mentioned Standards, 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 /6/2O18-PG dated 2nd July, 2020. h. RTU shall be enabled with System hardening viz. disabling/removal of unused ports and services. i. RTU Should support System Audit Logs, SYS logs etc. j. Enabling/disabling option of Web Server use
4.17	**Fibre Optic Cable**	Between Control Room and Switchyard/Switchgear Room: 4 Core, 62.5/125µm Multi-mode, Loose tube, Jelly filled, Armoured Fiber Optic Cable. Within Control Room: 2 Core, 62.5/125µm Multi-mode Fiber Optic Patch Chord.
4.18	**CAT – VI**	4 Pairs, 23 AWG Solid Bare Copper Conductor, PE Insulation, Unshielded Twisted Pair (UTP) with separator and PVC Outer Jacket It should be designed to the ANSI/TIA-568-C.2 | ISO / IEC 11801 Category 6 requirements and transmit data at 1000 Mbps (~1 Gigabit per second) with a

		frequency of 250 MHz and suitable for 10BASE-T, 100BASE-TX Fast Ethernet and 1000BASE-T / 1000BASE-TX (Gigabit Ethernet).
4.19	**RS 485 Cable**	1 Pair, 24 AWG Tinned Copper, PE Insulation, Overall Foil + Tinned Copper Braid (90%) Shield, PVC Outer Jacket
4.20	**Telephone Cable**	1 Pair, 0.5/0.63 sqmm Solid Bare Copper Conductor, PE Insulation, Telephone Cable with PVC Outer Jacket
4.21	**Maintenance Performance Requirements**	It is a requirement that all RTUs require no routine or planned maintenance. Therefore, no fans or moving parts shall be used in the RTU to avoid any need for maintenance. To ensure this, the RTU should be constructed to resist the entry of dust. A single technician shall be able to remove and replace for repair purposes, without special tools and test equipment, all equipment involved in the operation of an RTU. 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 RTU in order to replace a module.
4.22	**Service Life**	TPSODL prefers that the equipment shall be capable of complying with this standard, including performing its intended purpose, for a minimum of 15years from the date of supply. 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 supplied. • The anticipated date that product support will be withdrawn, i.e. spares will no longer be available and technical support is no longer provided.
4.23	**Inter-changeability**	RTU parts shall be interchangeable individually, and as a whole RTU. Any such change or replacement shall not reduce the capability of the equipment to conform to the requirements of this specification.
4.24	**Reliability**	The equipment will normally remain in continuous service to provide SCADA facilities. Failure can result in the interruption of the operation of the Power System Control and a high level of reliability is therefore required.

<table>
<tr><td></td><td></td><td>The supplier shall provide the predicted mean time to failure and the mean time to repair of the equipment. Where insufficient historical data is available, the supplier shall state the methods used to determine the reliability performance.

Predicted availability of equipment supplied should exceed the following:
<table>
<tr><th>System Function</th><th>System Availability</th></tr>
<tr><td>Control and monitoring of any one breaker</td><td>99.99%</td></tr>
<tr><td>Monitoring of any one single alarm</td><td>99.99%</td></tr>
<tr><td>Monitoring of any one analogue input</td><td>99.99%</td></tr>
</table></td></tr>
<tr><td>4.25</td><td>Remote Monitoring and Maintenance</td><td>The vendor should provide a configuration and diagnostic software which should able to access the Data Concentrator and all the other IEDs using the TPSODL TCP/IP WAN network. This software shall include facilities for:
Monitoring of all inputs, control of all outputs and testing of calculation logic. Monitoring of all inputs and logic at card level, logic level and protocol level.
Display of communications statistics and eavesdropping of communications channels, including Ethernet, IP, IEC 104, IEC 61850 and Modbus.
Download & upload of RTU software, database configuration and calculations, upload the complete configuration from RTU to modify and then download to RTU.
On-line help.
Display current firmware, software and configuration running in the RTU
Configuration and diagnostic software must run on latest Microsoft Windows.
The diagnostic and configuration utility software shall be provided on a CD/DVD that is compatible with the laptop PC. The current version number of such software shall be provided.</td></tr>
<tr><td>4.26</td><td>Grounding</td><td>Grounding is required for all equipment. Control and data acquisition equipment shall not ground a floating power source. Care shall be exercised to ensure ground compatibility when grounded power sources are used. Separate 2 no. of pits required RTU panel connected separately which will be connected with the Grid Earthing mesh, supply of pits is not in manufacturer scope but connection to up to pits to be provided.</td></tr>
</table>

		Separate trench for cable laying for communication, automation & IED equipment shall be provided.
4.27	**Device Grounding**	Cabinets and device enclosures shall be grounded only at the same point that the electrical service or UPS neutral is grounded. All devices within one cabinet shall be grounded together by means of a ground cable or strap. Earthing Strip (Copper) shall be available in RTU panel for device earthing.
4.28	**Signal or Instrumentation Grounding**	The signal or instrumentation circuit ground shall be connected to an external ground at a single point so that ground loop conditions are minimized. The shielded wire, drain wire, and/or ground wire of input/output cables shall be terminated at one ground point in each cabinet or the device shall be insulated from the cabinet. These ground points shall be connected together and connected to the facility ground. Caution shall be taken to prevent inadvertent ground paths from apparatus such as convenience outlets, conduit, structural metal, test equipment, and external interfaces. The manufacturer shall be consulted prior to selection of the cable end to be bonded as the optimal location is dependent upon the manufacturer's design choices. A special caution on filtering is worth noting. If the noise is shunted to the signal ground, then it becomes another source of signal reference corruption. Sometimes separate power, noise, digital, and analog ground buses are necessary. However, the NEC requirement for a single point safety grounding source shall always be met. A very important design rule is to keep all signal reference voltages, at all frequencies of operation, as close to zero as possible (i.e., at zero voltage signal reference).
4.29	**Fibre Optic Grounding**	Fibre optic circuits require no grounding unless the cable has a conductive element
4.30	**Electrical Circuit Grounding**	Where grounding is provided with the power source, safety grounding conductors shall be bundled with the power source conductors, but be insulated from the power conductors and from other equipment and wiring conduit. The ground conductor shall be terminated in the cabinet enclosure, and grounded

		only at the same point that the source of the electrical service to the cabinet or UPS neutral is grounded.
4.31	**Extendibility in Future**	Offered substation automation system shall be suitable for extension in future for additional bays. During such requirement, all the drawings and configurations, alarm/event list etc. displayed shall be designed in such a manner that its extension shall be easily performed by the employer. During such event, normal operation of the existing substation shall be unaffected and system shall not require a shutdown. The contractor shall provide all necessary software tools along with source codes to perform addition of bays in future and complete integration with SAS by the user. These software tools shall be able to configure IED, add additional analogue variable, alarm list, event list, modify interlocking logics etc. for additional bays/equipment which shall be added in future. Offered substation automation system including switches shall have minimum 20% spare port for future extendibility.
4.32	**Power Supply**	Power for the substation automation system shall be derived from substation 24/48V DC system. In the event of Power failure, necessary safeguard software shall be built for proper shutdown and restart.
4.33	**Low Voltage Control Cables**	0.5 sqmm cable, 1.5 sqmm cable for circuit inside panel and 2.5 sqmm cable for circuit outside panel for Relays and RTU wiring shall be of 1.1kV class Low voltage cables of stranded copper conductor, PVC insulated. Cables shall be laid in Cables trays and in indoor trenches as a complete system. Trays shall be supported properly from the building structure. The entire cable tray system shall be rigid and leveled. The installation of cable tray support system shall be using the required accessories and using grip bolts for proper strength in fixing. All the above required material shall be supplied and installed by the bidder. Control cables shall be stranded copper conductor having minimum 7 strands, extruded PVC inner sheathed, galvanised steel wire armoured, over all sheathed, outer sheath (ST-2) made of FRLS PVC compound. The cables shall conform to IS-1554 (Part-1) 1988/IEC-60502 (1998) & IEC-60502- amendment -1 999 in all other respects. In situations where accuracy of measurement or voltage drop in control circuit warrants, higher cross sections as required shall be used.
4.43	**Low Voltage Power Cables**	L T Power cables for the 415V AC, 240V AC system and 24V/48V DC system shall be single core/ Multi core 1100V earthed H4 grade with stranded aluminium/copper conductor, extruded cross-linked polyethylene (XLPE) insulated, core identification by colour coding, extruded PVC (Type -ST 2) inner sheathed, armoured, 27luminium wire armour for single core cables and galvanized steel wire for multi core cables and extruded PVC (Type ST-2) outer sheathed with FRLS properties, generally conforming to IS: 7098 (Part 1). Upto 16 sq.mm cables, Copper conductor shall be used and above 16 sq.mm cables, Aluminium conductor shall

<table>
<tr><td></td><td></td><td>be used for L T power cables. For DC all cables shall be of Copper conductor irrespective of its size.</td></tr>
<tr><td>5.0</td><td>General Construction</td><td>RTU/DCU shall have separate Panel and shall complied to the following
• RTU/DC Panel shall have simplex dust proof design with front and rear door, front door shall design with glass.
• RTU/DC Panel shall have rack mounted arrangement.
• RTU/DC panel shall have dual exhaust Fan system for heat dissipation.
• RTU/DC panel shall have copper earthing strip.
• RTU/DC Panel shall be placed properly in Control Room
• Doors shall have handles with either built-in locking facility or will be provided with pad-lock.</td></tr>
<tr><td>5.1</td><td>Outdoor Kiosk for housing Control & Relay panels and RTU panels</td><td>The outdoor kiosks to be used for housing max 20 numbers control and relay panels in two rows having control and protection IEDs for performing sub-station automation and protection functions will be made of “sandwich insulated panels” 80 mm thick with Poly Urethane Foam (PUF) as filler material between polyester pre-coated cold rolled steel. The insulation characteristics of PUF material will conform to following requirement:
<table>
<tr><th>SN</th><th>Particulars</th><th>Parameters</th></tr>
<tr><td>1.</td><td>Thickness</td><td>78.6 mm</td></tr>
<tr><td>2.</td><td>Density</td><td>40 kg/m^3</td></tr>
<tr><td>3.</td><td>Compressive Strength</td><td>1.2 kg.cm^3</td></tr>
<tr><td>4.</td><td>Tensile Strength</td><td>3.6 kg/m^2</td></tr>
<tr><td>5.</td><td>Bending Strength</td><td>4.0 kg/m^2</td></tr>
<tr><td>6</td><td>Adhesion Strength</td><td>2.9 kg/m^2</td></tr>
<tr><td>7.</td><td>Dimension Stability</td><td>At -25^{o}C : 0.1%
and at 38 ^{o}C : 0.4%</td></tr>
<tr><td>8.</td><td>Temperature Range</td><td>-15 ^{o}C to 95 ^{o}C</td></tr>
<tr><td>9.</td><td>Thermal Conductivity</td><td>0.02 kcal/hr/m/ ^{o}C</td></tr>
<tr><td>10.</td><td>Fire Resistance</td><td>As per BS-4735 Horizontal Burn
<125 mm</td></tr>
<tr><td>11.</td><td>Water absorption</td><td>0.2% @ 100% RH</td></tr>
<tr><td>12.</td><td>Vapour Permeability</td><td>0.08/0.12 g/hr/m^2</td></tr>
<tr><td>13.</td><td>Self-Extinguishing</td><td>Yes</td></tr>
<tr><td>14.</td><td>Biodegradable</td><td>Yes</td></tr>
</table>
The thickness of the inner and outer steel sheet except floor panel sheet will be minimum 0.8 mm and 0.6 mm respectively. The outer bottom sheet will be hot</td></tr>
</table>

		dip galvanised steel sheets to avoid rusting at bottom and will be of sufficient thickness to support the cables. The sandwich panels will be manufactured by high pressure injection techniques. The floor of the kiosk will be suitably designed for accommodating the control and relay IEDs in the panels. Adequate lighting and fire detectors will be provided in the kiosk. The kiosk will have adequate space for working and maintenance clearances as per requirement of Indian Electricity Rules. The kiosk will be provided with locking arrangement. The paint shade of kiosks will be RAL 7032. The kiosk will be completely dust proof and weather proof with a degree of protection IP55. The whole kiosk will be designed to be sufficiently strong and rigid. To ensure this, required reinforcement will be provided to the frames. These kiosks will be placed in the switchyard area generally unmanned, therefore, ventilation system comprising exhaust fans and fresh air fans shall be designed considering 20 nos Control and Relay panels inside the kiosk. Each Control and Relay panel will have two numerical relays, one MFM, 4 aux relays, annunciator and control switches. Also provision for future AC system shall be kept which shall be rugged, reliable, maintenance free and designed for long life. The ventilation system (or future air conditioning system) is required for maintaining the temperature for critical sub-station control and protection equipment. To provide reliability for such critical applications, each kiosk will be installed with dust removing filters. The system will be designed for 24 hours, 365 days of the year to maintain the inside kiosk temperature for proper operation of the critical equipment. To ensure longer life of the system a temperature monitoring system will be provided with alarm contacts wired to SCADA system for annunciation. The kiosk will be erected at least 300 mm above the finished ground level with suitable pedestal to avoid any entry of water. Foundation drawing for the same for housing 20 number Control and Relay panels, is in bidder's scope. The minimum distance between panels facing each other will be 1.2m. One kiosk meeting the specified requirement as described above, will be fabricated at the factory and offered for inspection at the factory. This kiosk will be equipped with all required accessories like cutout for ventilation / air-conditioning system, fire and smoke detector, lighting, various cut outs for panel erection etc. The kiosk will be tested for dust and rain protection to check out any leakage and air tightness. The following main tests will be carried out:

		a) Illumination inside the kiosk will be switched off and it will be checked that no light enters through panel joints, holes and other joints in the kiosk. b) Water leakage test (with a water pipe with suitable pressure from all sides for one hour.) c) Working and functional tests of all accessories like fresh air wall mounted fans system, exhaust fans, fire and smoke detector, lighting arrangements as per technical specification d) The total heat load for panels and devices to be placed inside the kiosk including all IEDs etc. will be calculated and equivalent calculated heating load (maximum value from among the calculated values for various kiosk) will be placed inside the kiosk and the kiosk will be made operational for four hours with all accessories and inside & outside temperature of kiosk will be recorded. On successful completion of proto testing, all other kiosks will be manufactured after incorporation of all alteration/modifications observed/suggested during/after proto testing. The detail test procedure will be submitted by the contractor and get it approved by the owner before commencement of proto testing. The material received at TPSODL, Berhampur, Odisha store shall be inspected for acceptance and shall be liable for rejection, if found different from the reports of the pre-dispatch inspection. **QUALITY CONTROL:** The bidder shall have a prove track of not less than 5 years in manufacturing and servicing of the items in Indian market .The bidder shall submit with the offer Quality assurance plan indicating the various stages of inspection, the tests and checks which will be carried out on the material of construction, components during manufacture and bought out items and fully assembled component and equipment after finishing. As part of the plan, a schedule for stage and final inspection within the parameters of the delivery schedule shall be furnished. The Purchaser's engineer or its nominated representative shall have free access to the manufacturer’s/sub-supplier's works to carry out inspections.

		The Bidder shall invariably furnish following information along with his bid, failing which the bid shall be liable for rejection. Information shall be separately given for individual type of equipment offered. Statement giving list of important raw materials, names of sub-suppliers for the raw materials, list of standards according to which the raw materials are tested. List of tests normally carried out on raw materials in the presence of Bidder's representative, copies of test certificates. Information and copies of test certificates as in (a) above in respect of bought out accessories. List of manufacturing facilities available. Quality Assurance Plan (QAP) with holds points for purchaser's inspection. The successful Bidder shall within 10 days of placement of order, submit following information to the purchaser. List of raw materials as well as bought out accessories and the names of sub-Suppliers selected from those furnished along with offer. Type test certificates of the raw materials and bought out accessories. The successful Bidder shall submit the routine test certificates of bought out accessories and central excise passes for raw material at the time of routine testing. NAMEPLATE: Name plate shall be provided with non-rusting metal or 3-ply lamicold with white engraved lettering on black base ground for easy identification. This shall be positioned so as to be clearly visible. **DRAWINGS AND DOCUMENTS:** Following documents shall be prepared based on TPSODL specifications 1. Technical Particulars. 2. General Arrangement drawing of the equipment 3. Plan and Section drawing 4. Foundation drawing 5. Bill of Material 6. Type test Certificates if applicable After the award of the contract, four (4) copies of the drawings, drawn to scale, describing the equipment in detail shall be forwarded for approval and shall subsequently provide four (4) complete sets of final drawings, one of which shall be auto positive suitable for reproduction, before the dispatch of the equipment. Soft copy (Compact Disk CD) of all the drawing,

<table>
<tr>
<td></td>
<td></td>
<td>GTP, test certificates shall be submitted after the final approval of the same to the TPSODL.
Following Drawings/Documents shall be submitted after the award of the contract:
<table>
<tr><th>S. No</th><th>Description</th><th>For Approval</th><th>For Review Information</th><th>Final Submission</th></tr>
<tr><td>1</td><td>Technical Parameters</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>2</td><td>General Arrangement drawing</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>3</td><td>Plan & Section drawings</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>4</td><td>Foundation drawing</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>5</td><td>QA & QC Plan</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>6</td><td>Routine, Acceptance and Type test Certificates as applicable</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>7</td><td>Site tests and checks</td><td>√</td><td>√</td><td>√</td></tr>
</table>
</td>
</tr>
<tr>
<td>6.0</td>
<td>Name Plate & Marking</td>
<td>A sticker shall be fixed to each material like RTU/DCU, IEDs, Ethernet Switches, Firewall, TMU and Energy Meters in a visible position and shall carry all the information as specified in the standards.
The following information shall be mentioned on the Sticker.
(i) Serial number
(ii) Warranty/guarantee details
(iii) Purchase order with date
(iv) “PROPERTY OF TPSODL”

A sticker shall be fixed on each MCBs/Fuses in a visible position and shall carry the information to which it feeds the power supply.</td>
</tr>
</table>

ANNEXURE - II

TPSODL

Specifications for Automation Equipment and Kiosk

7.0	**Tests**	**Factory Acceptance Test:** The manufacturing phase of the SAS shall be concluded by the factory acceptance test (FAT). The purpose is to ensure that the Contractor has interpreted the specified requirements correctly and that the FAT includes checking to the degree required by the user. The general philosophy shall be to deliver a system to site only after it has been thoroughly tested and its specified performance has been verified, as far as site conditions can be simulated in a test lab. If the FAT comprises only a certain portion of the system for practical reason, Database shall be prepared completely as per actual site requirement and it will submit to TPSODL for validation. An integrated-FAT shall be conducted as per the TPSODL I-FAT Document (ENG-EHV-1006 Rev. 00 -Annexure-III). If the complete system consists of parts from various suppliers or some parts are already installed on site, in such case supplier will arrange the intra-communication between RTU/DC and such IEDs to meet the requirement. **Hardware Integration Tests** shall be performed on the specified systems to be used for Factory tests when the hardware has been installed in the factory. The operation of each item shall be verified as an integral part of system. Applicable hardware diagnostics shall be used to verify that each hardware component is completely operational and assembled into a configuration capable of supporting software integration and factory testing of the system. The equipment expansion capability shall also be verified during the hardware integration tests. **Integrated System Tests** shall verify the stability of the hardware and the software. During the tests all functions shall run concurrently and all equipment shall operate a continuous 100 Hours period. The integrated system test shall ensure the SAS is free of improper interactions between software and hardware while the system is operating as a whole.
8.0	**Type Test Certificate**	The bidder shall furnish the type test certificates of following tests as per the corresponding standards for RTU. Type tests should have been conducted in certified Test laboratories and shall not be more than 5 years old from the date of opening the bid. In the event of any discrepancy in the test reports, i.e., any test report not acceptable same shall be carried out without any cost implication to Purchaser. For type test of Energy Meter, please refer Clause 4.14 Energy Meter.

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Name of the Test	Standard	Equipment Status	Test Level	Passing Criteria
Immunity Test				
Electrostatic Discharge	IEC 61000-4-2 IEC 60870-2-1 IEC 60255-22-2	ON	8 kV air (level 3) 6 kV contact (level 3)	Performance criteria A
Radiated Radio-Frequency Electromagnetic Field	IEC 61000-4-3 IEC 60870-2-1 EC 60255-22-3	ON	10 V/m (level 3)	Performance criteria A
Electrical Fast Transient / Burst	IEC 61000-4-4 IEC 60870-2-1 IEC 60255-22-4	ON	2 kV (level 3)	Performance criteria A
Surge	IEC 61000-4-5 IEC 60870-2-1	ON	2 kV (level 3)	Performance criteria A
Conducted Disturbances induced by RF Fields	IEC 61000-4-6 IEC 60870-2-1	ON	10 V (level 3)	Performance criteria A
Power Frequency Magnetic Field*	IEC 61000-4-8 IEC 60870-2-1	ON	30/300 A/m (level-3)	Performance criteria A
Damped Oscillatory Magnetic Field*	IEC 61000-4-10 IEC 60870-2-1	ON	30 A/m (level-3)	Performance criteria A
Damped Oscillatory Wave*	IEC 61000-4-12 IEC 60870-2-1 IEC 60255-22-1	ON	2.5 kV (level 3)	Performance criteria A
Insulation Tests				
Power Frequency Voltage Withstand	IEC 60870-2-1	OFF	1 kV_{rms} for 1 minute	No break down or flashover shall occur
Impulse voltage Withstand	IEC 60870-2-1	OFF	2 kVp	No break down or flashover shall occur
Insulation Resistance		OFF	Measure Insulation resistance using 500 V DC Megger before & after Power Frequency & Impulse Voltage Withstand Tests	
Environmental Test				

		Cold Test	IEC 60068-2-1	ON	Continuous operation at 0^0C for 16 hours	Normal performance within the specified limits. No failure.
		Dry Heat Test	IEC 60068-2-2	ON	Continuous operation at 55^0C for 16 hours	Normal performance within the specified limits. No failure.
		Damp Heat Test	IEC 60068-2-38	ON	Continuous operation at 95% RH and 40^0C for 16 hours	Normal performance within the specified limits. No failure.
9.0	**Pre-Dispatch inspection**	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 the equipment if found unsatisfactory as to workmanship or material, the same is liable to rejection. Bidder shall grant free access to the places of manufacture to Purchaser's representatives at all times when the work is in progress. Inspection by the Purchaser or its authorized representatives shall not relieve the supplier of his obligation of furnishing equipment in accordance with the specifications. Material shall be dispatched after specific MDCC (Material Dispatch Clearance Certificate) is issued by the Purchaser. Following documents shall be sent along with material: a) Test reports b) MDCC issued by TPSODL c) Invoice in duplicate d) Packing list e) Drawings & catalogue f) Guarantee / Warrantee card g) Delivery Challan h) Other Documents (as applicable)				
10.0	**Inspection after receipt at Stores**	Equipment/material received at TPSODL's store shall be inspected by Stores Department and shall be liable for rejection, if found different from Pre-Dispatch Inspection Report. One copy of the Inspection Report shall be sent to the Automation Department.				

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11.0	**Guarantee / Warranty Details**	Bidder shall stand guarantee towards design, materials, workmanship & quality of process/manufacturing of items under the contract for due and intended performance of the same, as an integrated product delivered under this contract for 60 months. In the event any defect is found by the Company up to a period of 60 months from the date of commissioning supplier shall be liable to undertake to replace such defects at his own costs within the mutually agreed timeframe, and to the entire satisfaction of the Company, failing which the Company will be at liberty to get it replaced/rectified at supplier's risks and costs and recover all such expenses plus the Company's own charges (@ 20% of expenses incurred), from the supplier or from the "Security cum Performance Deposit" as the case may be. Bidder shall further be responsible for 'free replacement' for another period of three years from the end of the guarantee period for any 'Latent Defects' if noticed and reported by the Company.
12.0	**Packing**	Bidder shall ensure that all equipment covered by this specification shall be prepared for rail/road transport (local equipment) and be packed in such a manner as to protect it from damage in transit.
13.0	**Training**	Contractor personnel who are experienced instructors and who speak understandable English shall conduct training. The contractor shall arrange on its own cost all hardware training platform required for successful training and understanding in India at manufacturer's work. The Contractor shall provide all necessary training material including configuration document in advance (before FAT or during FAT). Each trainee shall receive individual copies of all technical manuals and all other documents used for training. These materials shall be sent to Employer at least two months before the scheduled commencement of the particular training course. Class materials, including the documents sent before the training courses as well as class handouts, shall become the property of Employer. Employer reserves the right to copy such materials, but for in-house training and use only. Hands-on training shall utilize equipment identical to that being supplied to Employer. For all training courses, the travel (e.g., airfare) and per-diem expenses will borne by the participants. The schedule, location and detailed contents of each course will be finalized during Employer and Contractor discussions.

		System Hardware Course A computer system hardware course shall be offered, but at the system level only. The training course shall be designed to give Employer hardware personnel sufficient 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 contract maintenance personnel. The following subjects shall be covered: ▪ System Hardware Overview: Configuration of the system hardware. ▪ Equipment Maintenance: Basic theory of operation, maintenance techniques and diagnostic procedures for each element of the computer system, e.g., processors, auxiliary memories, LANs, routers and printers. Configuration of all the hardware equipment. ▪ System Expansion: Techniques and procedures to expand and add equipment such as loggers, monitors, and communication channels. ▪ System Maintenance: Theory of operation and maintenance of the hardware configuration, failover hardware, configuration control panels, and failover switches. Maintenance of protective devices and power supplies. ▪ Subsystem Maintenance: ▪ Theory of design and operation, maintenance techniques and practices, diagnostic procedures, and (where applicable) expansion techniques and procedures. Classes shall include hands-on training for the specific subsystems that are part of Employer's equipment or part of similarly designed and configured subsystems. All interfaces to the computing equipment shall be taught in detail. ▪ Operational Training: Practical training on preventive and corrective maintenance of all equipment, including use of special tools and instruments. This training shall be provided on Employer equipment, or on similarly configured systems. **System Software Course** The Contractor shall provide a computer system software course that covers the following subjects: ▪ System Programming: Including all applicable programming languages and all stand-alone service and utility packages provided with the system. An introduction to software architecture, Effect of tuning parameters (OS software, Network software, database software etc.) on

		the performance of the system. ▪ Operating System: Including 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 ▪ System Initialization and Failover: Including design, theory of operation, and practice ▪ Diagnostics: Including the execution of diagnostic procedures and the interpretation of diagnostic outputs, ▪ Software Documentation: Orientation in the organization and use of system software documentation. ▪ Hands-on Training: One week, with allocated computer time for trainee performance of unstructured exercises and with the course instructor available for assistance as necessary. **Application Software Course** The Contractor shall provide a comprehensive application software courses covering all applications including the database and display building course. The training shall include: ▪ Overview: Block diagrams of the application software and data flows. Programming standards and program interface conventions. ▪ Application Functions: Functional capabilities, design, and major algorithms. Associated maintenance and expansion techniques. ▪ Software Development: Techniques and conventions to be used for the preparation and integration of new software functions. ▪ Software Generation: Generation of application software from source code and associated software configuration control procedures. ▪ Software Documentation: Orientation in the organization and use of functional and detailed design documentation and of programmer and user manuals. ▪ Hands-on Training: One week, with allocated computer time for trainee performance of unstructured exercises and with the course instructor available for assistance as necessary. **Requirement of Training** The contractor shall provide training for a batch (maximum of 10 people) for five days on the following courses.

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<td>Name of Course

System Hardware
System Software
Application Software

<table>
<tr><th>Day</th><th>First Half</th><th>Second Half</th></tr>
<tr><td>Day 1</td><td>PPT/Live demo-based session on SAS Architecture, RTU Hardware Structure & details, details of existing developed supportive cards and devices, Firewall Switch & Manageable Ethernet Switch.</td><td>PPT/Live demo-based session on SAS Architecture, RTU Hardware Structure & details, details of existing developed supportive cards and devices, Firewall Switch & Manageable Ethernet Switch.</td></tr>
<tr><td>Day 2</td><td>Theoretical PPT based session on Protocols, especially on IEC 61850, IEC- 104, IEC103, Modbus RTU/TCP/IP</td><td>Practice on live system as per first half given session (majorly Configuration of ICD/CID & SCD File and its configuration on BCPU/BPU)</td></tr>
<tr><td>Day 3</td><td>Theoretical PPT based session on RTU Database creation, configuration of ICD/CID/SCD file in RTU.</td><td>Practice on live system as per first half given session (Database Creation on all Protocols, configuration of ICD/CID/SCD file in RTU)</td></tr>
<tr><td>Day 4</td><td>Theoretical PPT based session on PLC Configuration, Cyber Security, SNMP, diagnostics, system log analyze.</td><td>Practice of first half given session on live system</td></tr>
<tr><td>Day 5</td><td>Practice on configuration of Firewall Switch & Manageable Ethernet Switch with data analysis on Wireshark or equivalent software.</td><td>Other Queries related discussion, Test/Examination and Certificate Distribution</td></tr>
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<td>14.0</td>
<td>Quality Control</td>
<td>The bidder shall submit with the offer, quality assurance plan indicating the various stages of inspection, the tests and checks which will be carried out on the material of construction, components during manufacture and after finishing, bought out items and fully assembled component and equipment including drives. As part of the plan, a schedule for stage and final inspection</td>
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		within the parameters of the delivery schedule shall be furnished. The purchaser's engineer or its nominated representative shall have free access to the manufacturer/sub-supplier's works to carry out inspections.
15.0	**Minimum Testing Facilities**	The Bidder shall have in house testing facilities for carrying out all routine tests and acceptance tests as per relevant international/Indian standards.
16.0	**Manufacturing Activities**	The successful bidder will have to submit the bar chart for various manufacturing activities clearly elaborating each stage, with quantity. This bar chart shall be in line with the Quality assurance plan submitted with the offer. The bar chart will have to be submitted within 15 days from the release of the order.
17.0	**Services, Spares, Accessories and Tools**	
17.1	**Support Services SLA**	Services to be included during guarantee period 1. Guarantee shall be for 60 months from the date of commissioning 2. Vendor shall conform in a signed SLA to the following guidelines to mitigate major failures. To mitigate major failure like Complete system failure, RTU, DCU, 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 a. Vendor shall report to site within 48 hours of receipt of reporting of the failure occurrence. b. Vendor 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 vendor. c. Vendor always will provide detailed analysis report of the faulty equipment within 15 days from the date of the site visit by BA d. Any spare Equipment replacement, testing and its commissioning to be done by vendor only without any cost implications. Any equipment, any software or any hardware to test the IEDs/RTU to be borne by vendor only. e. Any up gradation in application software and RTU (except hardware) will be informed to us and necessary up gradation to be carried out by vendor without any cost implications. Services to be included during tender

		1. Tri-party agreement to be made to have protection against quitting of executing vendor. 2. Vendor to share Spare parts cost for RTU which will be valid for next 10 years. 3. Vendor need to provide life cycle support and supplies to ensure necessary support in terms of services and spares for next 15 years from date of Purchase Order. Vendor shall provide expected life of IEDs in writing.
18.0	**Drawing and Documents**	Following drawings and documents shall be prepared on Purchaser's specifications and statutory requirements and shall be submitted with the bid: 1. Completely filled in Technical Particulars 2. General description of the equipment and all components including brochures 3. Bill of material 4. Type test certificates 5. System Architecture Drawing 6. Hardware Specification 7. Sizing Calculations of various components 8. Response Time Calculation 9. Functional Design Document 10. Power Distribution Schematic Diagrams for each RTU 11. Standard documentation per IED, according to IEC 61850 12. MICS document (model implementation conformance statement), 13. PICS (protocol implementation conformance statement), 14. Conformance test certificate, 15. ICD/CID Cite (IED capability description file) 16. SCD file (substation configuration description) 17. MIB Files of RTU, TMU, Ethernet Switches & Firewall After the award of the contract four (4) copies of drawings, drawn to scale, describing the equipment in detail shall be forwarded for approval and shall subsequently provide four (4) complete sets of final drawings, one of which shall be auto positive suitable for reproduction, before the dispatch of the equipment. Soft copy (Compact Disk CD) of all the drawing, GTP, Test certificates shall be submitted after the final approval of the same to purchaser.

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		All the documents & drawings shall be in English language. Instruction Manuals: Bidder shall furnish two softcopies (CD) and four (4) hard copies of nicely bound manuals (in English language) covering erection and maintenance instructions and all relevant information and drawings pertaining to the main equipment as well as auxiliary devices.
19.0	**Guaranteed Technical Particulars**	Bidder shall submit separate sheet showing guaranteed technical particulars
19.1	**RTU/DC**	

S. No.	Guaranteed Technical Particular	Bidder Response
1	All the cards/modules of the RTU/DC must have conformal coating for protection against harsh environments.	
2	The RTU/Data Concentrator should be designed for 5000 I/Os.	
3	The RTU/Data Concentrator should support IEC 61850, IEC 60870-5-101, IEC 60870-5-103, IEC 60870-5-104, Modbus RTU, Modbus TCP/IP, DNP3.0 Serial and DNP3.0 TCP/IP	
4	There should be a provision to simulate the I/Os from the RTU	
5	There should be option to download (RTU to Laptop) the existing configuration from the RTU/Data Concentrator	
6	Data concentrator should support all the Data Types i.e., all Type Identifiers as specified in IEC 60870-5-104 for remote communication.	
7	Should have an ability to collect data from all connected devices, regardless of protocol and make it available to the control centers & HMI using a LAN/WAN connectivity.	
8	Should communicate to minimum 8 masters simultaneously on IEC 60870-5-104 protocol on a same CASDU	
9	Should be capable of handling real time data exchange services to publish or subscribe information for defined master and slave protocols.	
10	Should provide of Hardware diagnostics, System initialization, Watchdog management functions	

		11	Should provide for time & millisecond synchronization function.	
		12	Should provide latest Microsoft Windows based maintenance and configuration tools. The tools should have functionality of both remote and local access.	
		13	Minimum functionalities to be provided through these tools are device configuration, security settings, log files, communication traces and system statistics.	
		14	It should have hardware design comprising CPU, Power Supply, Communication Modules and Bus Interface Unit/Card.	
		15	Data Concentrator should support IEC 61131-3 with necessary license.	
		16	Data concentrator should have following the cyber security features (a) Access Management (b) System Audit Logs (c) Events Management (d) System Hardening (e) Secured connection via SSH/SFTP/HTTPS	
		17	Should support SNMP v1.0/2.0/3.0 (as Client and server both) feature.	
		18	Auxiliary power supply for the RTU/DC should have in the range of 24VDC or 48VDC depends upon Station DC Supply with tolerance of ±15%.	
		19	The RTU shall have a real time clock, with a resolution of 1ms. It shall have the capability of time stamping events. The RTU clock is normally synchronized by the SCADA FEPs. In the event that this does not occur, the RTU clock shall drift no more than 1 second in 24 hours.	

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