TECHNICAL SPECIFICATIONS

Sr.No	Item Description	
1	RTU - CPU (Central Processing Unit)	
2	Digital Input Module	
3	Digital Output Module	
4	Analog Input Module	
6	RTU Software	
7	RTU Panel	
8	Type Test report	
9	Graphical user interface	
10	Multi Function Meter	
11	Multi Function Transducer	
12	Cables	
13	GETCO scope of work	
14	GTP	

Technical Specifications of Main CPU Processor

Technical Features of CPU

CPU must support following technical features: -

CPU should be secure, hardened, advanced substation gateway that collects metering, status, event, and fault report data from serial or LAN based intelligent substation devices. The summarizes data from the substation devices and makes it available locally /remotely through a standard secure web browser (HTTPS). It supports serial and/or LAN connections to SCADA masters. TCP/IP network connections are supported over the built-in Ethernet and the modem interface.

Advanced Gateway

CPU should have advanced substation gateway, when operating as a SCADA host, collects, filters and sorts data from a wide range of intelligent devices (RTU, relays, meters etc) in the substation and preserves original data time stamp for accurate sequence of event.

Data can be presented to multiple SCADA hosts. CPU comes with a built in suite of protocols and security applications to facilitate communication with various substation devices and SCADA host, including:

- DNP3 serial and TCP/IP (client & server)
- IEC 61850
- Modbus serial & TCP/IP (client & server)
- IEC60870-5-101/104 (client)
- IEC60870-5-101/104 (server)

IEC 61850 Gateway

The IEC 61850 Client application allows to act as a powerful IEC61850 data concentrator.it also includes valuable features such as dynamic data sets, buffered control blocks and enhanced security controls.

Media/Communication Connectivity

- Minimum 2 Nos of Serial Ports (Supports both RS232/ RS485)
- Minimum 2 Ethernet ports (10/100 Mbps)
- RTU shall have debugging port for maintenance activity

Device Protocols

- DNP3 Serial, DNP3 TCP/UDP
- IEC61850 Client
- Modbus Serial (RTU), Modbus TCP
- IEC60870-5-101(Server/client)
- IEC60870-5-104(Server/Client)
- SNMP

Analog Report Generation

In addition to the data logging capability within the CPU, users can configure the CPU to record and generate online and offline reports from operation and non-operation analog data. While online reports can be retrieved instantly and are an extension of the data logger periodic, reports, offline reports can be retrieved daily, weekly.

Offline Reports

- Users can use the Analog report application to generate offline reports.
- Users can configure different types of analog reports. For example: Shift, daily, weekly Users can use the offline report viewer to view generated reports
- Output format types includes: PDF, Excel® and HTML

Online Reports

- This is an extension of the data logger periodic reports
- Users can use the online report viewer to view periodic data logger reports
- Output format types includes: PDF, Excel®

Mathematical Control Logic

Using the calculator tool, users can create advanced solutions that group, manage and control points to produce the required automation results. The calculator tool can perform mathematical, logical, or timer based operations on data points stored in the CPU. Using a graphical interface, users can define logical expressions using mathematical functions such as; addition, multiplication, logarithm, greater than, less than, as well as other boolean functions.

Fault Recording/ Data Logging

CPU can automatically retrieve event and oscillography files from devices such as Multilin UR Protective Relays, Controllers, and IEC 61850, server devices.

Secure Remote Access

Role based Access Control, Secure Web Interface, Secure File Transfer, and extensive user activity logging provide a complete security toolkit required to achieve NERC-CIP compliance. CPU must support the all cyber security features.

Remotely Upload & download database

CPU must support the remotely uploading and downloading the rtu database as and when required and it can be accessed through web browser with secure remote connection and required authentication for the same.

Non-operational Data

Using pass-through connections, the utility user can extract valuable non-operational data such as digital fault recording (DFR) records and event files. The user can also access the historical log files and upload the archived data for trending and analysis.

Network Security Protocol:-

- HTTPS
- SSH
- SCP

Built-in Firewall

CPU must be equipped with a built-in firewall for enhanced gateway cyber security. firewall is designed to drop unsolicited or invalid routed packages. The firewall is preconfigured to block undefined traffic on external interfaces and inbound traffic on both internal and external interfaces. CPU should automatically generate rules allowing inbound traffic on internal interfaces for all configured services The rules are user configurable for inbound/outbound traffic customization. CPU shall have all cyber security compliance.

Design Characteristics

All software shall be implemented according to established design and coding standards. Purchaser reserves the right to reject any software that does not conform to these standards.

Complete and comprehensive documentation shall be provided for all software.
The software and the database shall be sized to accommodate growth within the sizing Parameters defined for the RTU without requiring software or database regeneration. The design of the software and the database shall not restrict future expansion beyond the sizing parameters. Expansion beyond the original design parameters may require software or database regeneration. At the time the RTU is accepted, all software delivered must be up to date and in final form, including all standard software changes and field changes initiated by the Contractor or the Contractor's suppliers prior to acceptance. The software documentation must reflect these changes.

Operating System

- The operating system shall support multi-tasking and multi-programming.
- The minimum real-time facilities to be provided shall include process, job, and database, and memory management, process synchronizing message services for communication between jobs, and device and interrupt handling.

Initialization/Restart Program

Software shall provide automatic restart of the RTU upon power restoration, memory party errors, hardware failures, and upon manual request. The software shall initialize the RTU and begin execution of the RTU functions without intervention by master station. All restarts shall be reported to the connected master stations.

RTU Operations Monitoring

Software shall be provided to continuously monitor operation of the RTU and report RTU hardware errors to the connected master stations. The software shall check for memory, processor, and input/output errors and failures.

RTU Configuration Support

RTU can be configured from remotely accessed and database can be upload and download remotely to the RTU. A RTU Configuration complier shall generate or modify the database of the RTUs. The database compiler shall provide error detection services and shall produce a printed listing of the input data and the resulting RTU configuration. It shall be possible to maintain the RTU database locally and from a master station using the web server function.

Diagnostic Software

The Contractor shall supply diagnostic software at free of cost, which monitors and individually tests each of the components of the RTU demonstrating all the capability of RTU as mentioned in this section. The diagnostics shall provide comprehensive user interaction and printout capabilities. User can view the logs, errors, warnings which are generated in the RTU and can mentioned the cause the errors, warnings and failure of device or RTU itself.

Exception Reporting

The RTU communication protocol shall report changes by exception. The communication protocol shall also support an update demand scan of all status data by master stations regardless of the lack of any change in data.

The reply to an exception scan request for status points shall consist of an indication of the presence or absence of a change of the status indication points in the RTU. A master station will then request the input of the changed points. The RTU shall continue to indicate exception changes until the master station acknowledges successful receipt of the changed data. The RTU shall report the current state of all status indication points to the master station in response to an update scan even if data has not changed.

The RTU communication protocol shall be capable of reporting status changes (COSI) by exception (spontaneous change of status indication). The communication protocol shall also support an update demand scan of all status data by master station regardless of the lack of any changed data. The RTU shall continue to indicate exception changes until the master station acknowledge successful receipt of the changed data. The status change indication shall be invariably communicated to the Master station along with the time Stamp.

RTU shall support reporting data to the master station in the following manner with,

a) Time stamp.
b) Cyclic, with configurable cycle time.
c) Spontaneous.

Bad quality data transfer:-

RTU shall have capability to detect the bad data coming from any device irrespective of MFM, IOT, Relay or any other peripheral device connected or communicated with RTU. RTU shall have capability to transfer bad data to remote control centre with quality flag.

Message security (to be defined in the protocol)

Each RTU communication message shall include an error code, the use of which shall result in a very low probability of an erroneous information frame (data) being accepted as valid.

The error code shall be determined and appended to the message for all messages transmitted by the RTU and verified by the RTU for all messages addressed and received by the RTU. Cyclic error detection codes such as Cyclic Redundancy Check (CRC) are required. High data integrity and consistency is required of the RTU protocols. The protocols used shall provide an adequately low Residual Error Rate (RER), depending on the Bit Error Rate (BER) of the line in use. The minimum required RER is as specified in IEC 870-5-101 protocols with the T-101 profile. This requires the following integrity:
BER RER
10-5 10-14
10-4 10-10
10-3 10-6

The implemented protocol shall ensure satisfactory performance at Bit Error Rate of 1x10-4

Function of CPU

1. Advanced microprocessor with Multi tasking Processing capabilities.
2. Programmable ports
3. Communication between Main Processor and I/O Modules shall be on high speed Communication ports of 100mbps.
4. Match co-processor
5. The Memory capacity of processor shall be minimum 512 MB Flash memory adequate for satisfactory function of system request.
6. The input voltage to the RTU power supply will be provided through 48 VDC / 110VDC.
7. Self diagnostic shall Program memory checksums, RAM test, Configuration verification, Interrupt controller verification, Serial port test, Watchdog and power monitor, Peripheral communication checks, Error logger.
8. CPU should be capable to show the error generated while communicating with Input / output module(Analog & digital module), with multiple master, internal errors, hardware failure, power supply issues, communication breaks with master or with input / output module etc.

09. CPU processor should not be hanged during internal process or processing the arithmetic logic.
10. CPU should be capable of processing multiple tasks at a time and should be able to communicate with digital module.
11. CPU should be compatible for communicating to Multi Function Meter over Modbus protocol on RS485 port.
12. Firmware or license upgradation support whenever required upto next 5 years.

14. Designed around an open ended distributed processing configuration consisting of main processor, peripheral I/O modules, termination panels, power supplies & communication equipment/interface.

15. Collecting, processing and transmitting status changes, accumulated values and analog values.
16. Time resolution for time tagged events 1 ms
17. Receiving and processing digital and analog commands from the master station(s).
18. Accepting polling messages from the master station(s)
19. Supporting data transmission rates from 50 to 9600 bits per second.
20. Supporting minimum four communication ports on outgoing side to interact with multiple Masters on con-current protocols. CPU should be capable of communicating with minimum 4 master control centre at a time without any time delay in operation.
21. Supporting multiple RS 485/RS232 port for communication line.
22. Support Multi-tasking, to enable RTU to concurrently scan input status, whilst executing application program or reporting functions.
23. Function of switching of channels if dual data communication channel is available.
24. The protocol for communication between RTU & Master sites shall be IEC 60870-5-101 and 104
25. The protocol for communication between RTU & Numerical relays shall be IEC 60870-5-103.
26. Modbus protocol support and IEC 61850 protocol support.

Programmable Logic Capability: -

The RTU shall support programmable logic capabilities, easy to use editing facilities. These facilities shall allow creation of programmable logic and computational algorithms for the RTU. The programmable logic capability shall enable the RTU to perform control functions such as closed-loop analog control, sequencing for equipment startup and shutdown, automatic failover control, and other such functions typically performed by Programmable Logic Controllers (PLCs).

The programming methods can also comply with IEC 61131-3, the emerging international standard for programmable logic controllers in following program languages:

Function block diagram (FBD)
Instruction List (IL)
Structured Text (ST)
Ladder Diagram (LD)
Sequential Function Chart (SFC)

The PLC programs shall run and perform multiple operational tasks at a time.

PLC programs shall have access to all process signal values as well as the process signal defined such as invalid, time, etc. PLC programs running distributed applications shall use the signal defined for secure and safe operation.

PLC shall use available Analog and Digital Inputs and perform user defined functions by using arithmetic, Logical functions, Time Delay and communicate output to RTU for execution. The process time between input and output should meet power system protection requirement.

FBD (Functional Block Diagram):-

FBD must have capability to create one block diagram for integration of all analog signals of one feeder and one block diagram for integration of all digital signals of one feeder. Multiple FBD for integration of analog and digital signals is not allowed for one feeder.

Technical Specifications of Digital Input Module

The digital input module shall be with separate microprocessor based, intelligent, modular unit, capable of data acquisition, control and local data processing. DI module must be capable of standalone operation for data acquisition and processing, so that when it is used in a non-fault tolerant configuration, it will continue its data acquisition, processing and programmable logic functions and subsequently update the Station Level Processor following elimination of the fault.

Digital Status Inputs

- The digital status input interface shall be capable of accepting isolated wet or dry contact status inputs. The Contractor shall supply necessary sensing voltage, current limiting, optical isolation, and denounce filtering independently for each digital status input.
- 32 Digital Input shall be integrated
- The Contractor supplied sensing volt shall not exceed 48 VDC.
- The contractor has to supply Auxiliary realy with 2 NO and 2 NC contact for integration of CB to the RTU.

- The contractor has to supply 4 INCH C channel for mounting of auxiliary relay at sub-station end.
- Number of inputs. Configurable for SPI/DPI and should be connected to the I/O Bus of the controller.
- The sensing voltage source shall be isolated from that of the RTUs logic power such that any noise or a short circuit across the sensing supply's output terminals would not disrupt the RTU operation other than the shorted digital status input.

- 1 ms resolution for time tagged messages is required for fault analysis. The RTU shall store all status changed for retrieval by the master stations.

- For communication delays or short-term failure of communication with a master station, the RTU shall store a minimum of 2000 status of change events. The RTU shall report any overflow of this status-changed buffer to the master stations.

It shall be possible to configure each status input for one of the following functions: -
1. Single status input
2. Change of state
3. Sequence of event (SOE) time tagging with resolution of ±1 ms.
4. The SOE buffer capability to store 1024 events.
5. Three-level programmable software filtering for denounces and chatters
6. Pulse accumulator; one of Form A, B, or C at 50 Hz maximum input rate 16 bit binary counter)
7. Alarm input
8. Trip/block protection signaling.
9. Hysteresis to prevent false state changes due to noise or other conditions.

Two-State Devices

All switching devices (breakers) shall be supported by a dual-contact status indication. Breakers with reclosing capability shall also be supported with momentary change detection (MCD).

All other status indications shall be two-stage single-contact inputs without MCD. Single-contact two-state status point inputs will be from a single normally open (NO) or normally closed (NC) contact. Dual-contact two-state status point inputs will be from two complementary contacts (one NO and one NC). A switching device status is valid only when one contact is closed and the other contact is open. Invalid states shall be reported when both contacts are open or both contacts are closed.

Momentary Change Detection

Two-state status input points with momentary change detection shall be used by purchaser for points where multiple operations (changes of state) can occur between RTU scans (e.g. breakers with reclosing devices that operate faster than the scan rate). The RTU shall be set to capture contact operations of 20 ms or more duration. Operations of less than 20 ms

duration shall be considered no change (contact bounce). The duration used to determine change versus bounce shall be adjustable from 4 to 25 ms in increments of 1 ms.

Digital Output Module: -

Digital Output module shall control and trip the existing feeder as per command receive from master RTU.

- 16-Digital Control Output shall be available in one card
- 1 ms time stamp accuracy
- Sampling interval shall be 10ms
- Compatible for both AC/DC supply range
- Supported ambient temperature / during operation -40 to 70 degree

S.O.E (Sequence of Event): -

The RTU shall support Sequence of Events (SOE) inputs. A single point may be both status and SOE. SOE shall be time-stamped to a resolution of 1 millisecond within the RTU. SOE single point to be integrated and defined in RTU.

CMR Relay: -

Bidder has to provide CMR Relay with two NO and two NC contact and CMR Relay shall be integrated in 220KV GETCO Sub-stations. Bidder has to submit the design of CMR for final approval and purchasing of the same. The quantity of the CMR will be as per actual conditions of the site.

Technical Specfications of Anlog input Module:-

Bidder has to provide analog input module having 16 AI and MFM for integration of analog data at GETCO sub-stations.

Bidder shall provide analog input module to integrate various analog signals in the GETCO sub-stations.) and it shall be compatible for various output signals like 4-20mA, 0-5mA, 0-10mA etc..

In case of MFM Input will be taken from the C.T./P.T of the feeder and integrated to Multi-Function Meter and output of MFM will be integrated to RTU over Modbus protocol.

Through Communication: Multi Function Meter (MFM) of 0.2S accuracy class, 3-Ph-4W and output of the MFM shall be communicating to RTU in Modbus protocol for providing analog input. The detail technical specification of MFM is given in the tender.

The RTU should capable of communicating with minimum 32 Nos of multi-function meter at a time on a single Modbus port on the RTU.

The RTU shall make all appropriate signal level conversion and conditioning to allow full utilization of Analog inputs and meaningful reasonability checking. Including signal conditioning components, the input impedance shall not be greater than 250.

Bidder shall provide Multi-function transducer for integration of tap position of the transformer at GETCO sub-stations and integrate with RTU.

Technical Specification of RTU Software

The software provided to support the functions of the RTUs should meet the characteristics described in this section. Real-Time Executive Software, a real-time operating system shall come with the firmware, characterized by:

RTU Processor: -

Main processor of RTU shall be capable of processing multiple logics at a time without effecting operation of other connected peripherals devices. Processor shall response according to the logics and provide output as per predefined methodology.

Communication Interface

The RTUs shall have the capability to support simultaneous communications with multiple Independent master stations, Each RTU shall be able to support communication ports as per technical specifications. These ports shall be capable of supporting communications to peripheral devices such as multiple SCADA master stations, solid-state meters, microprocessor-based relays and remote/local PCs etc.

The RTU shall simultaneously respond to independent scans and commands from master stations using a centralized controller and database. The RTU shall support the use of a different communication data exchange rate (bits per second), scanning cycle, and/or communication protocol to each master station. Also, each master station's data scan and control commands may be different for different data points within the RTU's database.

Master Station Communication interface

RTUs shall provide multiple communication ports for possible con-current communication to SCADA system/master stations. RTU should be able to communicate to upto 4 client/Master Devices

Local User Maintenance computer Interface

The RTUs shall include the interface to support the portable local computer configuration and maintenance/test terminal. The interface shall provide easy access to allow purchaser to use the maintenance terminal at the RTUs installed at the site.

Master Station Communication Protocol

Shall provide a communication protocol for communicating with master stations using the IEC 60870-5- 104 or IEC-101 protocol communication standard. The communication protocol shall support all the requirements of this standard. The communication protocol shall be

nonproprietary and the contractor shall provide complete description and documentation of the protocol to purchaser for future implementation of additional RTUs due to expansion of power system from supplier at the master stations. The RTU shall also be capable of supporting other communication protocols that may be required to communicate with additional master stations in the future.

Minimum Communication Port:-

RTU must have minimum Following ports for communication (on board on RTU or on additional module)

a. Two Nos. of RS485/RS232 port
b. Two Nos. of Ethernet port along with debugging port

RTU shall be equipped with configurable Com Ports to acquire Data from MFM directly on RS-485 Interface on MODBUS protocol.

However, final architecture of RTU shall be approved only after making site survey report of each location. The architecture shall be submitted by bidder for final approval of SLDC GETCO.

Minimum 30 Nos of MFM device can be integrated and communicated on single Modbus port on RTU at a time.

It should have minimum 4 of ports configurable for Modbus application and IEC-60870-5-104.

RTU should be able to communicate to upto 4 Master control centre.

Communication Channel Control

- RTU should be remotely accessed and configured over IEC 104 Protocol and secure private network.
- Protocol conversion is not allowed.
- The RTU shall perform as a slave on the communication channel to SCADA systems. The SCADA system master stations shall initiate all communication. Where the RTU must notify the master stations of an unusual condition at the RTU (such as a power fail/restoration or RTU malfunction) or must initiate the transfer of changed data, the notification shall be accomplished within the framework of the periodic data acquisition exchanges.

Communication certification:-

All device used for communication between sub-station and control centre end should have cyber security compliance.

Slave Mode:

The RTU shall perform as a slave on the communication channel to the Host. All communication shall be initiated by the SCADA system FEP/Master Station. The RTU must notify the master station and must initiate the transfer of changed data. The notification shall be accomplished within the framework of the periodic data acquisition exchanges.

Scan Groups:

RTUs shall be capable of getting assigned A/I, D/I points (Including points reported by exception) through Scan Groups. A scan group shall be specified set of data points within an RTU central data base, which will be communicated to Master station on specific scan request. The Communication protocol message length shall only limit a scan group size. Any RTU input point shall be assignable to any scan group.
The Bidder shall provide a convenient and flexible scheme for assigning points in the RTU to scan groups. He shall also provide all special equipment necessary to configure the RTU and assign points to scan groups.

Time Synchronization:-

All RTUs shall be capable of getting Time Synchronized with GPS Clock of Master.. The RTU time will be set from time synchronization messages received from a Master station. The RTU shall synchronize its internal clock with the Master station system clock.

Power Supply Protection

Over voltage and under voltage protection shall be provided within the RTU power supply to prevent the RTU internal logic from being damaged as a result of a component failure in the power supply and to prevent the RTU internal logic from becoming unstable and causing mal-operation as a result of voltage fluctuations.

RTUs shall be capable of performing with both: a) 230 V, 50 Hz. Single Phase AC Supply from a UPS (Must) or b) 110/220 V DC from Battery/Charger the RTU power supply shall supply all necessary power to Support RTU functions. The RTU power supply shall be sized to handle the maximum power requirements for the ultimate number of input and output points. In case of RTUs operating with DC Source, the RTUs shall operate with grounded input power. The RTU shall not place a ground on the input power. Each RTU shall have the capability of automatic start up and Initialization following restoration of power after an outage without need of master station interaction.

Noise Level

The audible nose generated by the RTU equipment shall not exceed 50 dbA one meter from the enclosure.

Environmental Requirements

The RTUs will be installed in control buildings without temperature or humidity control. The RTUs shall be capable of operating in ambient temperatures from –5 to + 55 ºC and relative humidity from 5 to 95%, non-condensing with rate of temperature change of 200 C/hour.

Maintainability

The RTU design shall facilitate isolation and correction of all failures. The features which promote rapid problem detection, isolation and replacement of failed components, shall be provided as following:

(a) Self-diagnostic capabilities within each RTU, which can be initiated at the RTU site.

(b) On-line error detection capabilities within the RTU and detailed reporting to the connected master stations of detected errors.

© Local indication of major RTU failures.

RTU Hang:-

RTU shall be so designed to accept valid queries from Master. It shall not accept any other message, which may render RTU to hang.

RTU Address:

RTU addresses shall be programmable within the RTU through Software Configuration means.

Minimum Features of RTU Software : -

1. Software should allow the user to upload the database into the RTU as and when required.
2. Software should allow the user to download the existing database from the RTU
3. Diagnostic tool should show the all logs and errors of RTUs generated during communication and internal operations.
4. Integrated, multi-tasking with structured efficient supervisory layer
5. Priority scheduling of processes in coordination with other tasks; user applications
6. Partitioned into sets of processes
7. Inter task communication and synchronization
8. Dynamic memory allocation
9. Real-time clock to maintain calendar and time, and perform RTU timing functions.

10. Efficient real-time responsiveness.
11. During initialization, memory self-diagnostics shall occur and then initialize the system hardware and various I/O devices.
12. Device drivers will be required for:
13. Software should allow the user to upload the database into the RTU as and when required.
14. Software should allow the user to download the existing database from the RTU
15. Managing input and output through the serial communication ports,
16. High-speed link to peripheral boards, and external high-speed port, if needed.
17. Interrupt controller and interrupt servicing procedure shall prioritize and process hardware interrupts as they occur.
18. Debugging tools shall allow users, via a PC, to monitor functions, examine memory,
19. perform communication port loop back tests, adjust modem communication port Settings, check CPU usage, and process profiling.

RTU Panel / Enclosures (At Sub-Station End):-

The RTUs will be installed in control buildings without temperature or humidity control. The RTUs shall be capable of operating in ambient temperatures from -5 to +55 DEG C and relative humidity from 5 to 95%, non-condensing. Racks shall be of standard Make. Freestanding indoor enclosures shall be provided for indoor RTUs. The dimensions of the enclosures shall be so designed to house all the equipments inside and provide ease of operation to operator. A pocket attached to the inside of the front door shall be provided to hold RTU Documentation. The front door shall have a key lockable handle.
The enclosure shall be indoor and meet IP 41 class specifications. Indoor enclosures shall have both top and bottom cable access with removable dust covers for all access holes.
Within the enclosure, hot-spot temperatures shall not exceed the recommended operation temperatures of the components. Suitable exhaust fans shall be provided to remove excess heat from the Cabinet. Equipment shall be sufficiently sturdy to withstand handling during shipment, placement, and start-up without damage. The shipment configuration shall adequately protect equipment from scraping, banging, or any other damage. The Bidder shall assume responsibility for the correction of all such damage upon receipt of the equipment at the Customer's receiving site.

During the period prior to permanent installation enclosures shall be stable with doors open. All RTU cabinet doors shall be removable without tools.

Each RTU shall be equipped with a fused/protected convenience power outlet inside the enclosure to power test instruments. The convenience outlet shall be consistent with standard Indian power service.

RTU shall have one bolted clamp type cable of stranded copper conductors for grounding cable connection. All internal RTU metal Components such as mounting rails and chassis shall be firmly grounded to the RTU cabinet. Multiple cabinet RTUs if present shall be bonded together.

Analog and digital inputs shall include shields on each pair of Cable. Signal and safety ground networks within the enclosure shall be provided. The safety ground shall be isolated from the signal ground. Ground wire of the ac power input shall always be used. The signal ground shall terminate at a separate stud connection. Each ground network shall be copper bus bar or cable.
All materials shall be the best commercial grade used in the manufacture of RTU equipment. All wire and cable connection and terminators shall be labelled for identification. All connection points/TBs for external cables and wires shall be easily accessible for connection/disconnection. They shall be labelled. All components and equipment shall be of current production from component manufacturers. To facilitate expansions and maintenance, modularity shall be employed throughout the hardware equipment. All wiring shall be neatly laced or clamped. Materials that are susceptible to corrosion shall not be used.

RTU panel shall be designed to accommodate all equipment includes CPU, Analog input module, digital input module, digital control module, weather sensor equipment etc and 20% spare shall be accommodate in addition to the existing I/O signal of the GETCO sub- stations. Bidder has to submit the RTU Panel drawing for finalization and approval.

Terminations:-
All connections for interconnecting wiring integral to the supplier's equipment shall be of a durable and reliable type.

Signal separation:-
All wire that carry out low level signals shall be adequately protected and separated from power wiring.

Pin and socket identification:-
Each pin and associated socket connection shall be clearly identified by a coding scheme that is uniform within each subsystem.

Plug and Receptacle Accessibility:-
All plugs and receptacles shall be mounted and positioned for ease of replacement or repair.

Cable Harnesses:-
Whenever possible, wire shall be bundled into harnesses formed by plastic or nylon cable ties.

Cable Routing:-
Cable shall be routed so that wires or insulation cannot be over flexed, pinched, or damaged by doors, drawers, disassembly, or by other operation required for installation, testing and maintenance.

Cable Accessibility:-
Cable and wiring shall be easily accessible by maintenance personnel.

Tagging:-
Each cable should be tagged with standard type of tagging material with proper name given by GETCO for identification of the feeder in the RTU panel at sub-station end and at SUB-SLDC end. Bidder has to submit the sample of tag and GETCO will provide final approval for manufacturing.

Cable Bending:
Cable shall be connected or disconnected easily without bending or crimping.

Cable mounting:-
Cable or wiring shall be mounted on stationary panel where Stress points shall not occur on connectors. Cable glands shall be provided wherever required.

Terminal Blocks:-
For interfacing of 3 Phase CT in-out and 3 Phase-4 Wire for PT Terminal blocks disconnecting type of Terminal Block to be provided. Terminal block design shall be submitted for final approval of GETCO.

Grounding:-

Each cabinet provided under this specification shall be grounded to Station Earth mat/Electronic Earth. Earthing and grounding of the RTU panel and other equipment will be in the scope of the bidder.

Equipment Assembly:-

Equipment shall be assembled to allow for easy access without disassembly of components contained within enclosures. Slide out or hinged mountings shall be employed where enclosures would otherwise prevent access to equipment. Equipment shall be mounted so as to provide easy access to test points, fuses, switches and all items requiring replacement adjustment or calibrations.

Wire ways:-

Wire ways and I/O cabling shall not interfere with removal, repair or adjustment of RTU power supplies, circuit cards and terminations.

Components:-

Components shall be selected which have quality levels that conform to standard engineering and industry requirements for comparable equipment. Solid state and other

electronic components shall be applied within their specified operating ranges. No components, which have been selected for special characteristics from a group of the supplier's standard product, shall be used unless specifically authorized by the purchaser .All discrete components, including semiconductors, resistors, capacitors, fuses and lamps, shall be selected in accordance with standard commercial and industrial quality assurance methods.

Environmental:-
The RTU will be installed in Power Station or Sub- Station control room without temperature or humidity control. The RTU shall be capable of operating in ambient temperature from -5 to + 55°C and relative humilities from 5 to 95% non-condensing.

Critical Up time:-
RTU should be designed to have critical up time of 99.9 %.

Reserve:
Each RTU shall provide a 20 % reserve capacity for connecting other points. This means that one additional card in each category should be fixed to provide for this Reserve capacity. However, each RTU shall be designed to provide 100 %

Maintainability:-

The RTU design shall facilitate isolation and corrections of all failures. The following features, which promote rapid problem isolation and replacement of failed components, shall be provided.

a) Self-diagnostic capabilities within each RTU, which can be initiated at the RTU site.
b) Local indication of major RTU failure.

Life Span:-

Each RTU shall have life of 10 years from the date of fixing. Bidder shall give **after Sales Product support for a minimum of 5 Years.**

Routine Test

All routine tests as per IEC is to be carried out by vendor on each RTU and report to be submitted for approval.

Acceptance Test:

Bidder has to offer the RTU for inspection at their works and acceptance tests as per IEC shall be carried out in presence of inspector of GETCO / SLDC.

Type Test:

Vendor should have to submit the type tests report as submitted during the vendor registration or conducted as per IEC for the offered RTU and equipments intend to supply, from the NABL accredited testing agencies. Type test report should not be older than 7 years. Following additional type test report can be submitted if bidder has carried out on their offered RTU model.

Additional TYPE TEST REPORTS FOR RTU AND ITS COMPONENT (Optional):-

A. CISPR 22 Class A - Conducted Emissions - Auxiliary power supply.
B. CISPR 22 Class A- Conducted Emissions - Telecommunication port.
C. CISPR 22 Class A - Radiated Emission - Enclosure Port.
D. IEC 61000-4-2 Electrostatic Discharge.
E. IEC 61000-4-3 Radiated Radio- Frequency Electromagnetic Field
F. IEC 61000-4-4 Fast Transient Burst
G. IEC 61000-4-5 Surge
H. IEC 61000-4-6 Conducted Disturbances, induced by radio-frequency fields.
I. IEC 61000-4-29 Voltage Dips and Interruptions.
J. IEC 61000-4-17 Ripple on D.C. power supply.
K. IEC 61000-4-18 Damped Oscillatory Wave

The equipment offered must have been above type tested after manufacture in India. Equipment shall be type tested if required by the purchaser in presence of purchaser or/and any third party.

Technical Specification of Graphics user interface

- GUI of the software should be user friendly.
- It can be easily accessible without any third-party software requirement.
- Every row value of the analog and status output can be seen in the GUI of the RTU.
- Sub-station database can be easily define, modified, delete, create as and when required through GUI.
- GUI should be compatible with windows OS and it can be compatible with windows 7 and onwards of windows versions.

- There should no compatibility issue for installation of software into the Laptop or desktop.
- Database can be uploaded into the RTU through GUI
- Database can be downloaded from the RTU into the laptop or desktop.
- Communication parameters can be seen in the GUI
- Healthiness of communication link between RTU and Master control centre.
- Healthiness of Digital Input module.
- Internal process running
- Indication for faulty hardware, failure of process, failure of communication link etc.
- Facility of username and password for authentication.
- Database can be copied from any station and can be inserted into the new station
- Defining of clock synchronization parameters
- RTU can be made master for other slave devices
- Remotely access the RTU through web applications.

Technical Specification of Multi-Function Meter for 220KV/132KV Sub-station

Multi Function meter shall be supplied as per requirement and as per following technical specifications. The quantity of the Multi function meter will be decided on the basis of site survey report.

Multifunction meter should be capable to monitor Active power, Reactive power, line current, P-N Voltage, frequency, voltage, power factor, total active power, average power factor, Active total Import/Export energy, total apparent power etc.

Multifunction meter should be communicated with RTU over Modbus protocol on RS 485.

Multifunction meter should be minimum 32 bit complied.

Sampling rate: Minimum 156 samples/cycle/channel. (OEM to certify)

Large four or three line seven digit display (9.7x5 mm) with quadrant identification section and bar graph for instantaneous power level indication.

High accuracy class 0.2s

Average THD measurement upto 31st order & individual harmonics for voltage, current, power up-to 15th order.

Measurement selection (star or delta/3-Ph 4 wire or 3-Ph 3 wire)

Modbus communication via RS485 port/Ethernet

True root mean squared (RMS) metering

Calibration LED for accuracy test on site

Wide and configurable current range 1-1.2A and 5-6A. Should be field configurable.

a. Field Configurable CT Ratio. Both side configurable as per user requirement
b. CT Secondary& CT Primary (Onsite Programmable Range)

Wide range auxiliary power, suitable for high voltages and or low voltages

Maximum demand recording

Expansion capability via add on modules for analog output or pulse input/ output and Ethernet

MFM with provision of ring type lug fixing capabilities are required to integrate with existing CT connections.

Operating voltages range- the offered meters operating range will vet +20% to -30% of normal voltage, i.e. 100V to 415V (Line values).
Operating frequency range: 50Hz with +/- 5% tolerance
Auxiliary Power Supply: 85-300V AC or 48 – 300V DC
Meter short time over current capacity: 20xImax for 1 sec or 7x Imax for 10 seconds
Meter shall start registering energy at 0.1% Ib

Burden
As per IS14697 Class 0.2s burden must not exceed below mentioned values:
Current Circuit: @1A & @ 5A 0.2VA per phase
Voltage Circuit: 0.2 VA per phase
Auxiliary Burden: < 8VA

LED
Meter must be provided with Calibration LED for accuracy testing on site, the LED could be configured for both active or apparent measurements.

MFM (Multi-Function Meter with Display) installed by bidder should have Modbus RS485 or Hot Pluggable Ethernet module for communication with Central Controller. The meter shall have 2 LED's. One for Metrology & second for events and alarms. Metrology LED should be on site configurable for Active/Apparent. It shall have self-diagnostic features to display the health condition of meter
Real time clock
The meter shall have a build in Real Time Clock
Meter mounting and dimensions
Mounting of meter: Flush mounted
Meters should have detachable connectors for easy installation.
Dimension (WxH): 96x96 without module/attachment.

Depth shall be <=65 mm w/0 module to accommodate for meter installation in existing panel.
Cut out size: 92x92mm

Environment Standards:-
IP 54 compliance for Front Fascia
Impulse withstand capacity: 6kV
Insulation: 4kV RMS @ 50Hz for 1 min> 100 M-Ohms
negative 10 degree to + 60 degree(operating)
-25 to +70 degree storage
Humidity: 95% non-condensing

Hardware and software capabilities
Meter shall communicate on RS485 Modbus RTU and data shall be available in floating point.
Communication baud rate range: 9600-38400 bps
Common metering hardware for both CT ratio 1A and 5A and all required PT ratio. The meter should be field configurable for the required CT and PT ratios. So that it can be used for any application like HT 3 Phase 4 Wire, HT 3 Phase 3 Wire or LTCT. These configurations settings should be password protected. This is to ensure minimum spares.
Meter must have configurable password protection for setup mode.
Midnight snapshot (values) for selected energies likewise MWh Import and Export, MVArh for all 4 quadrants, MVAh Import and Export.
Load Survey: 90 days for at least 6 parameters @ 15 minutes' integration period. IP. It shall be possible to configure IP for 5/15 min. This helps in data analysis requirement.
Meter shall be able to detect fault conditions such as missing potential, Voltage unbalance, Current unbalance, Reversal of Current, High Voltage, low voltage, Invalid voltage, invalid phase association etc.
Diagnostic assistance shall be provided on display for phase association to verify correct installation.

Display
The meter shall have multi Colour LCD/TFT 3/4- line 7 digit display preferably with bright green backlight. The display must have quadrant identification facility and bar-graph for instantaneous power-level indication.
The meter shall have 2 different modes for display.

Auto display mode**/**Quick Display page mode with selected parameters, 4-5 parameters in quick display page mode. Push button mode: Parameters scroll manually on pressing push button.
Large multi-colour display with quadrant identification section and bar graph
Power/Demand level indication

Instantaneous Parameters:
Phase wise line voltages and average line voltage
Phase wise phase voltages and Average phase voltage

Phase wise line currents and neutral current
Phase wise active currents
Phase wise reactive currents
Phase wise power factor and average power factor
Frequency.
Phase wise Active Power and Total Active power
Phase wise reactive power and Total reactive Power
Phase wise Apparent Power and Total Apparent Power

Energies
Active Total Import
Active Total Export
Apparent Import
Apparent Export
Reactive Import : Q1 + Q2
Reactive Export : Q3 + Q4

Additional Parameters
Power On/Off Hours
Load On/Off Hours
Phase wise Feeder interruption count (in absence of auxiliary power)
In addition meter may have configuration facility to select and group preferred display pages for quick viewing i.e. Favorite page display OR Auto display may be configured for selective Quick viewing display.

Future Expansion capability
Provision to allow addition of following modules as extension to existing meters. add on modules for analogue output or pulse input/outputs and Ethernet gateway module should be complied.

OEM confirmation certificate for future provision of detachable modules and associated specifications should be attached with the technical bid.
Password protection for setup mode.

Guarantee/Warranty certify by OEM:-
10 years from the date of installation at site, Certify via OEM.(The bidder should provide MAF from the OEM. The OEM should provide technical compliance to the technical specifications mention in the tender and same should be submitted along with technical bid.)

Type Test Report as per IS14697, Class 0.2s
Vendor shall have to submit the type test report for Accuracy class 0.2s as per IS14697 for the offered multi-function meter from NABL accredited testing agencies along with the offer. Type test report should not be older than 5 years.

Accuracy: Meter accuracy class 0.2s, Compliance as per IS14697.
Additionally, Accuracy class 0.2s for active, reactive and apparent Energy.
Please provide OEM certificate for Class 0.2s Accuracy compliance for Active, Reactive and Apparent energy in Technical bid.

Submit the following Type test report of MFM

1. Impulse Voltage Test
2. AC High Voltage Test
3. Insulation Resistance test
4. Limit of error
5. Test of meter constant
6. Test of starting condition
7. Test of No-Load test
8. Ambient temp test
9. Repeatability error test
10. Voltage variation test
11. Frequency variation test
12. 10% of THD in current circuit
13. Reverse Phase sequence
14. Voltage unbalance test
15. Phase of auxiliary supply voltage by 120 degree
16. Magnetic induction of external origin 0.5mT
17. Continuous Magnetic induction of external origin of .67Mt
18. Power Consumption
19. Test of influence of supply voltage
20. Short time over current test

GTP of the Multi Function Meter

Sr.No	Technical Features	Required	Offered by bidder – Yes/No.
1	MFM Make	Secure/SATEC/ABB/Schneider	
2	Model Number	-	
3	Number of bit required	32bit	
4	Communication	Modbus protocol-RS485/Ethernet	
5	Sampling rate	156 samples/cycle/channel	
6	Display	3 line or 4 line	
7	Accuracy class	0.2s	
8	Wide and configurable current range	1-1.2A and 5-6A. Should be field configurable.	
9	configuration	Can be configured through laptop or manual in MFM	
10	Expansion capability	via add on modules for analog output or pulse input/ output and	

		Ethernet	
11	Integration of CT connection	provision of ring type lug fixing capabilities are required to integrate with existing CT connections	
12	Accuracy: Meter accuracy class 0.2s, Compliance as per IS14697. Additionally, Accuracy class 0.2s for active, reactive and apparent Energy. Please provide OEM certificate for Class 0.2s Accuracy compliance for Active, Reactive and Apparent energy in Technical bid.	Specify % accuracy and provide OEM certificate for all below parameters. a. Voltage % b. Current % c. Active Power % d. Reactive Power % e. Apparent Power % f. Active Energy % g. Reactive Energy % h. Apparent Energy	
13	Operating voltages range	the offered meters operating range will vet +20% to -30% of normal voltage, i.e. 100V to 415V (Line values).	
14	Operating frequency range	50Hz with +/- 5% tolerance	
15	Auxiliary Power Supply	85-300V AC or 48 – 300 V DC	
16	Meter short time over current capacity	20xImax for 1 sec or 7x Imax for 10 seconds.	
17	Dimension	96x96(wxh)	
18	CT / PT Ratio	HT 3 Phase 4 Wire, HT 3 Phase 3 Wire or LTCT	
19	MVArh	for all 4 quadrants, MVAh Import and Export	
20	Guarantee/Warranty	10 years from the date of installation, Certify via OEM certify along with technical bid.	
21	Type Test Report	Not older than 5 years	
22	Meter short time over current capacity	20xImax for 1 sec or 7x Imax for 10 seconds.	
23	Compliance	IP54	

Technical Specification of Multi-Function Transducer

Multi function transducer shall be installed and commissioned to integrate tap position of various transformers at GETCO sub-stations

Multi-function transducer shall have accurate measurements and high response time. It shall measure the resistance value with high efficiency.

Sr.No	Technical Features	Required	Offered by bidder – Yes/No.
1	MFT Make	Secure/SATEC/ABB/Schneider	
2	Model Number	-	
3	Measuring range	0-100Ω to 0-14kΩ	
4	Voltage range	80-276 VDC/VAC Freq 50 Hz	
5	Maximum Burden	≤6 VA, 3W with one output at 750Ω ≤6 VA, 3W with two output at 750Ω	
6	Output type	mA	
7	Accuracy class	0.2	
8	Maximum Load resistance	≤750Ω for 20mA	
9	Response time	≤100-220ms	
10	Operating range	-5 to 55©	
11	Dimenstion	45x75x105	
12	Output range (In mA)	0-10,0-20, 4-20, 0-1,0-2,0-5	
13	Compliance standard	IEC 61010-1, IEC 61010-2-30, IEC 61326-1, DIN 50022	
14	Communication port Micro USB	For on-site configuration Can be configured through USB port, without auxiliary supply	
15	Protection	IP40	

Technical Specifications of LAPTOP (Ref: - Scope of work item Sr No.48)

Sr.No	Technical Features	Minimum Features Required	Offered by bidder – Yes/No.
1	Laptop Make	HP/DELL/ACER	
2	Processor type	Intel/AMD	
2	Model Number	-	
3	RAM	16GB	
4	Hard disk	1TB SSD +512/256gb SSD	
5	Resolution	Full HD Display (1920x1080)	
6	Screen Size	15.6” inch	
7	Windows License	11th or 12 or latest	

8	MS office License	Available (license)	
9	Webcam	Available	
10	Generation	12Th Generation or 11th Generation	
11	Core	i5 or i7 Processor	
12	Number of laptop	05Nos.	
13	USB Port	2	
14	For Ethernet	Standard DELL/HP Make USB TO LAN Convertor Cable -05Nos.	
15	Laptop BAG	Additional bag need to be provided	
16	Mouse	Additional mouse should be provided	

Technical Specification of Cables:-

1. **Following Cable should be used in CT/PT extension Wiring and input to MFM: -**

Sr.No	For CT Connection	For PT Connection
1	R (Red colour)- 2.5 sq mm insulated flexible cable	R (Red colour)- 1.5 sq mm insulated flexible cable
2	Y (Yellow colour) - 2.5 sq mm insulated flexible cable	Y (Yellow colour) - 1.5 sq mm insulated flexible cable
3	B(Blue colour)- 2.5 sq mm insulated flexible cable	B(Blue colour)- 1.5 sq mm insulated flexible cable
4	N(Black colour)- 2.5 sq mm insulated flexible cable	N(Black colour)- 1.5 sq mm insulated flexible cable

2. Following cable should be used for internal MFM wiring: -(Communication cable MFM TO MFM and MFM to RTU Panel)

0.5 sq mm 4 core shielded screened armored cable

3. Cable for Circuit breaker to digital input module (DI CARD): -

1.5 sq mm seven core armored. Same cable will be used for integration of digital input and SOE input upto RTU panel. (Auxiliary relay with two NO AND two NC contact and necessary C channel should be provided by bidder.

4. **Cable for SOE wiring**:

1.5sqmm 2 core shielded armored cable should be used for wiring between control panel and relay panel.

5. Cable for provide input supply to RTU: -

2.5sq mm 2 core shielded armored cable.
GETCO will provide the 48V DC/110VDC/220VDC power supply. Bidder has to lay the cable from power supply panel to RTU panel.

6. Cable for providing the earthing to RTU Panel:-

35sqmm single core copper cable provided by bidder for providing earthing to RTU panel at sub-station end. Common earthing of the sub-station will be provided by GETCO.

Individually shielded twisted pairs of wires with an overall shield may be used by the Customer for connections between the Multi function meter and the analog inputs at the RTUs. The system shall have high noise immunity from stray circulating currents in the cable shield.
Common-mode noise rejection: 90 dB minimum, 0 to 60 Hz. Normal-mode noise rejection: 60 dB minimums at 60 Hz. Adjacent channel voltage isolation: withstand the common- mode voltages of any two channels on the same analog input module differing at least 35 volts AC or peak AC.

GETCO SCOPE OF WORK:-

Communication; -

GETCO will provide communication between sub-station and control centre end

POWER SUPPLY:-

48V DC / 110V DC/220VDC at SUB-STATION END
110V AC/220V AC at Sub-SLDC end

RTU General Technical specifications & features:-

The RTU shall be compatible so as to work with existing GE SCADA system which supports IEC 60870-5- 104 and capable of performing the following functions:

(a) Designed around an open ended distributed processing configuration consisting of main processor, peripheral I/O modules, termination panels, power supplies & communication equipment/interface.
(b) Collecting, processing and transmitting status changes, accumulated values and analog values.
(c) Time resolution for time tagged events 1 ms
(d) Receiving and processing digital and analog commands from the master station(s).
(e) Accepting polling messages from the master station(s)
(f) Supporting data transmission rates from 50 to 9600 bits per second.
(g) Supporting minimum four communication ports on outgoing side to interact with multiple Masters on con-current protocols.
Support protocol multi protocol like IEC 104,IEC 101, MODBUS etc.
(h) Supporting up to 32 IEDs on a RS 485 port for communication line.
(i) Support Multi-tasking, to enable RTU to concurrently scan input status, whilst executing application program or reporting functions.
(j) The microprocessor-based common logic and have at least 1.5 MB Compact Flash RAM for storage of configuration files and shall support WEB server diagnosis.
(k) Function of switching of channels if dual data communication channel is available.
(l) The protocol for communication between RTU & Master sites shall be IEC 60870-5-101.
(m) support Multi-tasking, to enable RTU to concurrently scan input status, whilst executing application program or reporting functions.
(o) Modbus protocol support.

GUARANTEED TECHNICAL PARTICULARS

Sr.No	Description	Details/ Technical Value	Offered by bidder
1	Manufacturer's name	-	
2	Manufacturer's Address	-	
	Manufacture's Contact		
3	Authorized Dealer of Offered product	-	

4	RTU Make		
5	RTU Model Number		
6	Minimum Life of RTU		
7	Firmware or license details	.	
8	expansion	20% Expansion shall be available for all modules (i.e. Analog-digital module) to integrate future bays.	
9	Time Synchronization	With Master Control Centre	
10	IN BUILT RTC	Time stamps and cyclic execution are also based on internal real-time clock	
11	Data Storage	1000 Events	
12	Cyber security compliance and certification built in the RTU	Industrial IT Security in compliance with: IEC-62443-4-1:2018 IEC-62443-4-2:2019 PPP 15003:2021(IEC 62443-4-1:FULL ML3 PROCESS PROFILE)	
13	Relay integration over IEC-61850	Minimum 40 Nos of relay (Different type of relay-IEDs) can be integrated over IEC-61850 protocol.	