Section - 2.05

EMS AND COMMUNICATION SYSTEMS

1.0.0 General

This Specification covers the complete scope of work for the design, engineering, manufacture, fabrication, assembly, painting, pre-shipment testing at the manufacturer's works, proper packaging (for transportation to site), loading, forwarding, transportation, transit insurance, and delivery to site of the BESS SCADA system along with all required hardware, software, accessories, and spares. The system shall be supplied in a fully operational condition, acceptable to the Owner, and shall meet all duties and performance requirements necessary for efficient, safe, and trouble-free operation.

The Specification further includes the complete Erection, Testing, and Commissioning of the BESS EMS /SCADA system and all associated accessories at site. The entire scope of work shall be executed on a turnkey basis, ensuring that the Contractor delivers a fully functional and integrated BESS EMS/SCADA system ready for operation.

Energy Management System (EMS) system shall be a computerized system for real-time monitoring, operation, control, reliable & efficient operation and optimization of performance of the BESS Plant. SCADA system shall be part of EMS system. EMS shall be able to acquire real time data of various equipment of BESS system, have in built logic/programming to monitor, control, and optimize the performance of BESS as per specification.

SCADA system requires a focus on safety, real-time monitoring, grid compliance, and operational efficiency. The SCADA system must seamlessly integrate with the Battery Management System (BMS), Power Conversion System (PCS), and Energy Management System (EMS) and Thermal Management System. SCADA must support Power Plant Controller (PPC) functions to meet strict utility interconnections requirements.

Also, parameter visualization at 100% capacity level is also required for performance measurement of total BESS Plant.

Suitable provision for Remote control and monitoring facility EMS should be provided in addition to local control and monitoring so that all trouble-shooting and subsequent action can be taken from GIPCL corporate center. Necessary software at remote and local end shall be under scope of Bidder.

Contractor shall provide complete EMS system with all accessories, auxiliaries and associated equipment and cables for the safe, efficient and reliable operation of entire BESS Plant and its auxiliary systems. Contractor shall include in his proposal all the Industrial Grade Hardware, Software, Panels, Power Supply, HMI, Laser Printer, Gateway, Networking equipment and associated Cable etc. needed for the completeness even if the same are not specifically appearing in these specifications.

2.0.0 SCOPE OF WORK

2.1.0 The scope of work shall include the following:

- The scope of work under this package shall include supply of BESS EMS/ SCADA system along with all required hardware and accessories together with all spares in a fully operational condition acceptable to the Owner for the duties and services as specified herein and as required for efficient, safe, and trouble-free operation.
- Items though not specifically mentioned herein but are required to be included to make the equipment / system complete and to meet the intent & requirements of this specification shall be included in scope of the bidder.
- Design, engineering, supply, testing, packing and forwarding, transit insurance, delivery at site, Erection, pre-commissioning and commissioning of Energy Management System (EMS) along with required accessories and communication links for integrated monitoring and control of charging and discharging of BESS, active and reactive power control as well as voltage at the interconnection point, using standard and proven algorithms. All the cables, cable trays, erection hardware etc. are also included in bidder's scope.
- EMS shall be able to acquire real time data of the various equipment of BESS system and have built-in logic/programming to monitor, control and optimize the performance of BESS, based on the setpoints received from the GETCO Grid Substation.
- Bidder shall provide a complete EMS system (not limited to) with necessary hardware, software, interfaces, accessories, workstations, historian, data cables, accessories etc. for the safe, efficient and reliable operation of the entire BESS and its components from the Main Control Room of the Pooling substation.
- Software shall be provided for control/operation/protection/communication with relays/data acquisition of the BESS electrical system. Software licenses, with life cycle validity to be provided for all the applicable equipment.
- Local/Site Controller(s) which shall be geographically distributed across the plant area (as applicable) including all the necessary software licenses.
- Redundant Controller(s) at the Main Control Room include redundant communication cards and power supply which shall be located in main control room having interface with power plant controller.
- Power plant controller (PPC) shall be provided with two processors (main processing unit and memories), one for normal operation and one as hot standby. In case of failure of working PPC processor, there shall be an appropriate alarm and simultaneously the hot standby PPC processor shall take over the plant control function automatically. The transfer from main processor to standby processor shall be totally bump less and shall not cause any plant disturbance whatsoever. It shall be possible to keep any of the PPC processors as master and others as standby. The standby processor shall be updated in line with the changes made in working processor. The BESS plant SCADA and PPC networks shall be suitably designed, so that EMS shall be directly and independently able to control the individual PCS. Detailed control logic in the PPC shall be finalized during detailed engineering stage as per grid requirement to support voltage and frequency with suitable droop characteristic as per CEA standard.
- SCADA servers shall be provided for two Operator cum Engineering Workstations (OEWS), and a pair of redundant Historian servers. All these systems shall be located in the Main Control Room and equipped with 32-inch monitors for both OWS and EWS.

- SCADA shall also be able to acquire, display and store real time data, status and alarm signal from following equipment included but not limited to as required or offered under the scope of this specification:
    a. Battery containers with Aux system and VRFB Battery Controller
    b. All the HT Switchgear/RMU equipment
    c. PCS duty Transformers
    d. Incomer and bus coupler breaker of LT Panel.
    e. Power conditioning System (PCS)
    f. UPS and Battery charger as per requirement/ Auxiliary supply systems
    g. TEM/ABT/MFM meter, numerical relay, fire alarm panel, GPS time synchronization unit and Aux. transformers.
    h. SCADA Hardware, Accessories and Communication link
    i. Alarm also includes cell temperatures and fire suppression systems, including flame arrestors and gas and smoke detectors if any
    j. Any other equipment required to complete monitoring of BESS plant up to all voltage level.
- Display of status of major equipment in Single Line/Mimic Diagram. Mimic Diagram colour shall comply to IS 11954: Latest Guide for color coding of electrical mimic diagrams.
- Display and storage of derived / calculated / integrated values.
- Generate, store and retrieve user configurable periodic reports. EMS/SCADA shall have facility to generate reports in MS Excel file type.
- Remote monitoring of essential parameters of plant on the web using popular web browser without requirement of additional software. Same shall be authorised with user id and password using standard modem. User ID and password for remote view can only be changed by EMS/SCADA Administrator. Internet connection for transferring data to web shall be taken by Contractor in the name of GIPCL Site for O & M period.
- Three (3) Web Client Licenses shall be provided for remote monitoring, along with the required number of OWS, EWS, and Historian licenses as per the system configuration and their respective locations.
- Performing self-monitoring and diagnostic functions
- The contractor shall provide GPS clock, which shall be synchronized with the SCADA/EMS system. All devices having real-time clock (RTC) with time synchronization facility and are communicating with BESS EMS/SCADA shall be synchronized with GPS Clock through SCADA or directly with GPS Clock.
- SCADA shall provide real-time performance monitoring for the BESS, aligned with IEC -61724/IEC-62933 principles of data availability, accuracy, time-stamping, and reporting, with BESS-specific KPIs such as round-trip efficiency, availability, state of charge and energy throughput.

- The control system shall provide safe operation under all plant disturbances and on component failure so that under no condition the safety of plant, personnel or equipment is affected. Control system shall be designed to prevent abnormal swings due to loss of Control System power supply, failure of any Control System component, open circuit/short circuit. On any of these failures the controlled equipment/parameter shall either remain in last position before failure or shall come to fully open/close or on/off state as required for the safety of plant/personnel/equipment and as finalized during detailed engineering. System shall be designed such that there will be no upset when power is restored. This operation shall be demonstrated by vendor during Factory Accepted Test (FAT) in the presence of GIPCL's Representative.
- Bidder shall include in his proposal all the Industrial Grade Hardware, Firmware, Software, Panels, Power Supply, Networking equipment and associated Cable etc. needed for the completeness even if the same are not specifically appearing in these specifications. All electronic items supplied shall have conformal coating and industrial grade Hardware to withstand the harsh environment. Conformal coating shall be provided for all field devices for protection against harsh environmental condition G3 as per ISA 71.04-1985. Conformal coating products shall be tested and approved by EIA 364- 65A.
- All the power supply module, Ethernet switches and network accessories for non- air-conditioned areas shall be suitable for operating at an ambient temperature of 50 Deg C minimum.
- Managed Network Switches (with Copper and SFP Ports)
- Protocol Converters (as applicable)
- Gateway(s)
- Firewall(s)
- Light Interface Units (LIU)
- Operating and application software with Licenses
- A3/A4 Color Printers
- All control and communication cables with all their accessories
- Interface with Third-Party Safety systems (E.g.: Fire Alarm System)
- Assistance and close cooperation for end-to-end test for data and signal transferred from BESS plant to Load Dispatch Centre (if applicable), which shall include data points test, data communication and exchange tests.
- Bidder shall provide Industrial Grade of system hardware, ethernet switches and panels and they are classified as C4(ISO-9223)- Corrosion Class
- Conformal coating products shall be tested and approved by EIA 364-65A.
- Product shall meet MIL-1-46058C type UR conformal coating requirements.
- Bidder shall comply with the coating requirement as per National and International standard specification.
- All coated surfaces shall be protected against abrasion, impact, discoloration and any other damage. All exposed threaded portions shall be suitably protected with either

metallic or a non-metallic protection device. The parts which are likely to get rusted, due to exposure to weather, should also be properly treated and protected in a suitable manner. All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings.

- The material and services shall be conforming all aspects to a high standard of engineering, design and workmanship and shall be capable of performing in continuous commercial operation. OWNER has right to reject or accept any work or material which in his assessment is not complete to meet the requirements to the specification and/or applicable Indian/International standards, as applicable.
- Bidder to note that the proposed system shall be state-of-art technology and with proven in field track record. No prototype equipment shall be offered.
- As part of the performance monitoring, the following shall be carried out:
    a. The Contractor must install necessary equipment to continuously measure BESS operating parameters (including but not limited to voltage, current, ambient conditions etc.) as well as energy input into and energy output from the BESS along with Metering arrangement in accordance with extant regulations. They will be required to submit this data to Employer, GIPCL and GETCO online and/or through a report on regular basis every month for the entire duration of contract.
    b. The plant SCADA should be OPC version 2.0a (or a later version including OPC UA) compliant and implement appropriate OPC-DA server as per the specification of OPC Foundation. All data should be accessible through this OPC server for providing real time online data (BESS parameters). This time series data shall be available from the Project SCADA system to facilitate monitoring and should include among others as stated before, below parameters to facilitate daily, monthly and annual Report for performance monitoring.
    c. Web-based monitoring should be available, which should not be machine-dependent. The web-based monitoring should provide the same screens as available in the plant. Also, it should be possible to download reports from a remote web-client in PDF or Excel format.
- The technical details, designs, drawings, write up are minimum requirements, bidder to understand the system completely and shall bound to supply, commission the additional items or, services required for complete satisfactorily as Contractor and operation of SCADA System within their quoted price.
- Bidder scope shall include termination of all types of cables at both ends, testing and continuity check, supervision to erection of panels, racks, cabinets, workstations, servers etc., laying of cables, cable trays

3.0.0 CODES AND STANDARDS

The equipment to be furnished under this specification shall be in accordance with the applicable section of the latest version of the following Indian Standards, IEC publications and any other standards of latest edition including amendments, except where modified and /or supplemented by this specification.

IEC 61850	Communication protocols for intelligent electronic devices at electrical substations
IEC 60529	Rate and grade the resistance of enclosures of electric and electronic devices against the intrusion of dust and liquids.
IEC 61446	Minimum requirement for system documentation, commissioning tests and inspection
IEC 61724	Guideline for measurement, data exchange and analysis
IEC 60204-1	Requirements and recommendations related to the electrical equipment of machinery
IEC 60870-5-104	Tele control, tele protection, and other tele-communication functions for electric power systems
IEC 60870-5-101	Power system monitoring, control & associated communications for tele control, tele protection, and associated tele-communications for electric power systems
IEC 60256	Electricity Metering Data Exchange
IEC 62682	Management of Alarm Systems for the Process Industries
IEC 62443	Industrial Cyber Security Services.
EN 61000	Electromagnetic Compatibility (EMC) for Power Supplies
ITU-T G.652D	Single Mode Fiber Optic Cable Standard
EIA/TIA 598A	Optical Fiber Cable Color Coding
EIA/TIA 568	Telecommunications Cabling Standard
ISO/IECTR 11802	IT-Telecommunications and information exchange between systems-Local and Metropolitan Area Network

Bidder shall clearly indicate in their proposal the standards which the requested equipment meets. The supplier shall clearly indicate if field certification is required for any necessary standards. The Certification of equipment shall be the supplier's expenses. Bidders shall abide and comply applicable Grid code, Grid Connectivity Standards, Regulations on Communication System for transmission of electric and other Regulation/Procedures (as amended from time to time) issued by appropriate Commissions and Central Electrical Authority (CEA) for interconnection between grid and metering.

4.0.0 SYSTEM ARCHITECTURE OVERVIEW

4.1.0 Energy Management System shall be able to acquire real time data, display status and alarms /warning signals by interfacing with following system (not limited to below):

- Switchgear panels (relays, MFM, Energy meters, transducers, contacts)

- Auxiliary Power System comprising UPS, Battery, Battery Charger, Distribution Board (MFM) and contacts
- Energy Meters
- Power Conditioning System (PCS)
- Fire Alarm System (FAS)
- VRFB Battery / Electrolyte / Stack Controller
- HVAC (As applicable)
- Any other VRFB-specific auxiliary equipment (pumps, heat exchangers, tank sensors, safety systems)

4.2.0 The system interface shall not be limited to the above-mentioned systems, Bidder shall recommend in advance in case any more interfaces are required for completeness and safe operation of the system.

4.3.0 The SCADA equipment for all the nodes shall be provided with at least ten hours battery backup and extended backup shall be provided depending upon the requirement.

4.4.0 The number of Site/Local Controller(s) shall be optimized to manage and control DC Blocks and PCS for managing the overall active/reactive charge/dis-charge from the block. Based on the real time limitation on individual DC block and PCS site/local controller will provide the active/reactive set points to the individual PCS.

4.5.0 EMS SCADA shall comprise of control, monitoring and communication functions and shall provide all functions required for the safe and reliable operation of BESS. This shall be located at the Main Control Room.

4.6.0 The system shall be designed to ensure maximum availability by the inclusion of built-in redundancy for both hardware and software. This shall include Redundant hot-standby control processors, data highway and power supplies with automatic changeover to the standby unit upon detection of a fault or failure of the operating unit. The proposed system shall require it to be interfaced with existing system controller.

4.7.0 The servers shall be time synchronized from GPS based time servers on NTP.

4.8.0 The control system offered shall provide safe operation under all plant disturbances and component failure so that under no condition the safety of the plant, personnel or equipment is affected. Control System shall be designed to prevent abnormal swings due to loss of Control System power supply, failure of any Control System component, open circuit/short circuit.

4.9.0 EMS shall support following standard protocols but not limited to integration of various equipment and systems such as be IEC 61850 and IEC-101/104, IEC 61850-7-420:2021, MODBUS TCP/IP, RTU, DNP3, OPC-UA. MQTT etc.

4.10.0 Each site/local and central controller should have built-in cyber security feature and should be ISA secure EDSA level 2 certified.

4.11.0 EMS shall have the cyber security compliance, as per IEC 62443, ensuring the security of the BESS network, intrusion detection and prevention, port hardening, manage security services

like secure remote access, automatic patch update, application whitelisting, antivirus update, etc.

4.12.0 Servers shall act as data aggregators/concentrators and Controllers shall be responsible for running the logics and/or communicating with grid based on predefined scenarios or live conditions to control the charge/discharge of Battery systems.

4.13.0 Bidder shall offer EMS system which shall be integrated on cloud-based solutions for collecting the cell level Voltage and Temperatures on real-time basis, not only for the Battery warranty purposes, but also for the predictive alarms for the preventive maintenance purpose. The Controllers should be also capable of doing predictive failure analysis based on the cell level data and generating alarms for the Operators.

4.14.0 Bidder to note that the system shall be offered compliance with web-based solution to enable remote users to view the graphics same as the Operator with automatic data updating with proper authentication of the remote users.

4.15.0 EMS SCADA shall provide the capability to be controlled locally and remotely from OWNER's different geographical Control Centre. The Plant SCADA shall ensure automatic operation without presence of personnel during normal operation.

4.16.0 The entire BESS will be designed to minimize common mode failure. A unitization philosophy will be adopted for all systems and devices to ensure that the risk of unit trip due to common mode failure does not occur.

4.17.0 Furniture for all workstation and printers shall be provided.

4.18.0 Bidder to provide provision for hooking up laptop required for maintenance personnel.

4.19.0 The communication system shall be designed to ensure adequate redundancy.

4.20.0 Bidder shall be responsible for planning, design, implementation, secured operation and maintenance of its own communication infrastructure to be interfaced with the communication system of CTUIL / PGCIL / RLDC / SLDC / Regulatory Authorities.

4.21.0 Bidder shall furnish the requisite interface information to the appropriate control centre as specified by them.

4.22.0 Communication equipment installed shall be interoperable, to allow seamless integration between different vendors.

4.23.0 Confidentiality of data and information of the power system shall be maintained. Communication system access shall be designed, developed, built, configured and maintained in such a way that only authorised person has access.

4.24.0 The Vendor shall provide training for operation, maintenance and programming of the SCADA System and shall provide all necessary training material to Owner.

4.25.0 Servers shall be of industrial grade and state of the art. Processor and RAM shall be selected in such a manner that during normal operation not more than 30% capacity of processing and

memory are used. The capacity of hard disk shall be selected such that the following requirements will occupy less than 50% of disk space.

4.26.0 The communication infrastructure shall consist of a fiber optic, managed Ethernet Switch LAN in a dual fault tolerant ring configuration.

4.27.0 The data exchange among various levels takes place via the dual fiber optic inter-bay bus according to IEC 61850-8-1 standard for Numerical Relays.

4.28.0 The communication between Central EMS at Main Control Room and Field EMS shall be through Fiber Optic cable. There shall not be any limitation on the protocol implementation.

4.29.0 Redundant UPS Power Supply 240 VAC shall be provided to the Servers, Network Switches, OWS, EWS, Gateway, Firewall and Time Server. Communication equipment for all the nodes shall be provided with at least ten hours battery backup and extended backup shall be provided depending upon the requirement.

4.30.0 The system shall meet the requirements of CEA (Cyber Security in Power Sector) Guidelines, 2021.

4.31.0 The architecture for control system shall be designed with security such that it is important that the selection process ensures that the level of protection is commensurate with the business risk and the system security shall not rely on one single security measure for its defence. (Reference IEC/TR62351-10 Edition1.0 2012-10 Power systems management and associated information exchange –Data and communications security – Part 10: Security architecture guidelines)

4.32.0 There is hard isolation of OT (Operational Technology) system from any internet facing IT system.

4.33.0 If required only one OT system shall be provided with internet and it shall be isolated from all OT zone and kept in separate room under control and security of Owner, IT representative.

4.34.0 List of whitelisted IP addresses for each firewall shall be provided, and each firewall shall be configured for allowing communication with the whitelisted IP addresses only.

5.0.0 FUNCTIONAL REQUIREMENTS

The following EMS Functions are proposed under this tender specification

5.1.0 DATA ACQUISITION

- EMS Controller shall interface with all plant equipment using open communication protocols (IEC-61850, IEC-104, Modbus TCP/IP, OPC-UA, etc.).
- All PCS, VRFB Battery / Electrolyte / Stack Controller, switchgear, protection relays, and utility metering shall be integrated with the EMS/SCADA system.
- PLC / (RTU) shall be used to collect data from the PCS, Incoming and Outgoing panels, UPS system and the transformer to transfer data to the SCADA system which will carry out key control and monitoring functions of the plant.

- Alarm contacts (WTI, OTI. BUCHOLZ, PRV) from transformers and status of Load Break switch from HT switchgear shall be wired to SCADA system through RTU DI cards.
- Numeric relays shall be connected to SCADA through IEC 61850.
- EMS SCADA located in Central Control Room comprises of Operator Workstation (OWS) and Engineering Workstation (EWS) and Historian servers.
- EMS SCADA shall accumulate the Breaker/Isolator Status, Metering information through Digital/Analog data. SCADA shall have Digital Output facility to Control the breaker/isolator through IEC 61850 protocol. SCADA shall communicate with PQM, tariff meters and panel meter on MODBUS protocol.
- Digital Status and Analog values data shall be reported by exception and shall be updated and displayed.
- Digital status data shall have higher priority than the Analog data.
- The system shall have dead band for data by exception.
- All analog values except energy values shall be reported by exception.
- EMS SCADA will perform the periodic integrity scan, apart to which scan shall be initiated automatically for the conditions below:
    a) Upon startup of the system
    b) Controller/RTU status change is detected such as restart, communication link restoration
    c) On Demand of EMS function
    d) On request by the User
- In case of signal failure EMS system shall be marked with a 'signal failure quality code' and alarm shall be generated.
- The last good value/status shall be retained in the database for each affected point.
- When signal gets healthy, the associated EMS system shall automatically resume updating the database with the scanned data.

5.2.0 DATA PROCESSING

Data Processing involves a value which has been converted to internal form and analyzed for violation of limits. The data processing shall set various data attributes depending on the results of the checks and shall trigger any additional processing or calculation.

- **ANALOG DATA PROCESSING**

  Analog data processing shall be performed according to the requirements listed below.
    a) Conversion to Engineering Units
    b) Zero dead band processing
    c) Reasonability Limit Check
    d) Limit Monitoring

e) Rate of change /Gradient

f) Sign Conventions

g) Accumulator Processing

- **DIGITAL INPUT DATA PROCESSING**

Each state of a digital input point shall be associated with the state of an actual device. A status point shall be defined as being either legal or illegal, and normal or abnormal.

a) Illegal state: The first check on a new input to a digital status point is the legality check. If the new state is illegal, then the old value shall be left in the database and marked old with relevant quality code such as signal failure etc.

b) Abnormal state: If the new state is legal, it shall be checked to see if it is among the normal states defined for the point. If not, the status point shall be marked as abnormal. While abnormal, it shall appear in the summary display of abnormal conditions summary.

c) Alarm checking: The following digital input data types shall be accommodated as a minimum:

d) Two-State Points: The following pairs of state names shall be provided as minimum

i. Open/Closed
ii. Tripped/Closed
iii. Alarm/Normal or Reset
iv. On/Off
v. Auto/Manual
vi. Remote/Local
vii. Appear/Disappear
viii. On Control/Off Control
ix. Set/Reset
x. Operated/Reset
xi. Healthy/Unhealthy
xii. Service/Test
xiii. Charge/Discharge
xiv. Available/Unavailable
xv. Grounded/Ungrounded
xvi. High/Normal
xvii. Raise/Lower
xviii. Trip/Reset

e) Three State Points: Any of the state combinations listed above shall be supported with a third, typically, in-transit state which is in the case for slow operating devices. If a device remains in this state for a period more than a threshold value, the same shall be alarmed.

f) Commanded Changes – Commanded changes initiated by control shall not be alarmed but shall generate an event message. All other status changes in the state of telemetered, calculated digital input points and un-commanded changes shall be alarmed.

- **CALCULATED DATA PROCESSING**

a) EMS system shall be capable of performing calculations and storing the result in the database as calculated data available for display.

b) The database variables to be used for arguments and the mathematical/statistical/ logical function to be used as operation shall be definable interactively at a console as well as by the programmer using database creation and maintenance procedures.

c) Calculated analog values shall use database points as the arguments and mathematical and statistical function as the operations.

d) Functions such as addition. Subtraction, multiplication, division, maximum, minimum and average value, count, integration, square root extraction, exponentiation, trigonometric functions, logarithms and logical and comparative operators etc shall be provided.

e) It shall be possible to calculate running maximum, minimum and average value over a time interval which shall be configurable. The value shall be reset after the elapse of defined time interval. These values shall be stored with time of occurrence for maxima and minima and the time for averaging.

f) Calculated status values shall use database points as arguments and combinational logic functions that include the logical, comparative operators such as AND, inclusive OR and exclusive OR, NOT, less than, greater than, Less than or equal to, Greater than or equal to, and Equal To, If, Else if etc. suitable rules or operators shall be provided to indicate the sequence of operations in the calculation.

g) User defined calculation criteria shall be selectable by user programmer. Criteria's are as following:

i. On Change of any of the analog input variable
ii. Periodic

h) Irrespective of the quality flag of involved calculation members, calculation shall continue to run, and result should have quality flag as per the precedence table of quality flags.

- **SUBSTATION TOPOLOGY**

a) EMS system shall be provided with a substation topology processor function. This function shall be capable of analyzing the open/closed status of switching devices, such as breakers and disconnectors, in order to define the configuration of the substation for display.

b) The energization of lines, transformers, bus sections and generating units shall be determined so that the associated displays may correctly show the status of these power system elements.

c) The configuration shall be re-evaluated and updated whenever a switching device status change and analog value change beyond dead band is detected.

- **ALTERNATE SOURCE OF DATA**

  a) The system shall have the capability to accept multiple data sources by defining them as main & secondary. Normally, data from normal sources will be considered. In the event of non-availability of primary source, data from secondary sources shall be considered & once primary source is healthy, it shall switch back to primary source.

  b) There shall be an indication for primary /secondary source in displays, reports etc. A suitable alarm shall be generated in the event to change from primary to secondary & vice versa. Alternate sources of data can be defined for certain critical points in the database.

- **CREATING LOGIC USING ANALOG AND DIGITAL DATA**

  a) There shall be tool for numeric and status calculations and OWNER specific function development. This tool shall be available without requiring any software license. This tool shall work in online environment.

  b) There shall be easy interface to access the programs and edit. The program/functions shall be configured to trigger based on change in Analog and Status change, periodic or timer based and user input.

  c) EMS system shall have a feature to update/train the algorithm/ML based optimization model from time to time.

5.3.0 TIME SYNCHRONIZATION

- Time Synchronization equipment shall be provided and shall be located in the Control Room. It shall receive Coordinated Universal Time (UTC) transmitted through Geo Positioning Satellite (GPS) for time synchronization of all components of the SCADA.
- It shall be complete in all respects including antenna, all cables, processing equipment, etc.
- All auxiliary systems and special cables required for synchronization of the equipment shall be supplied and commissioned by the Contractor.
- It shall work from DC supplies only and the Contractor to clarify if any built-in battery backup is provided, in which case, same shall be of long-life lithium batteries.
- It shall be immune to hostile electrical environment. Suitable protections are to be provided against lightning surges and over-voltages in power supply systems and antenna feeders.
- The system shall be fully tested to the relevant international standards such as IEC: 801 and IEC: 255.
- All components of the Switchyard SAS, including Substation Controllers, Workstations, Bay Control Units (BCU) and Bay Protection units (BPU) and all numeric protection relays, PCS, Battery Controller etc covering all equipment's of BESS shall be synchronized with an accuracy of 1ms.

- The GPS shall be synchronized with the SCADA system to be supplied under this contract. Necessary software and Hardware (including laying of communication cable) required for time synchronization with SCADA and all other devises shall be in scope of contractor.
- The system should be able to track more than 1 satellite at a time to ensure no interruptions of synchronization signals.
- The system shall have provisions for combination of any of the following output signals:
  a. NTP (network time protocol) 100Mbits Ethernet port
  b. IRIG-B00x (TTL, pulse width modulated signal)
  c. 2 x Pulse per half-hour/ Pulse per minute/ Pulse per second outputs via potential free contacts
  d. Any other output port as may be required for the offered system.
  e. Alarm status contact indicating healthy status of system
  f. These output ports shall be compatible with the requirement of the equipment to be synchronized i.e. BCUs/ BPUs/Numerical Relays/IEDs etc as per scope of the specification. The master clock in control room shall also be synchronized with the time synchronization system. The actual port requirements (no./type) in line with the system offered shall be finalized during detailed engineering.
  g. The equipment should have a periodic time correction facility of one-sec. periodicity. The equipment shall also have real-time display in hour, minute, and second (24-hour mode) and have a separate time display, having display size of approx. 144mm height.

5.4.0 CONTINUOUS REAL TIME DATA STORAGE AND PLAYBACK

- All real-time data (Analog and status) shall be continuously stored in Server or auxiliary memory for at least One Month and automatically transferred to non-erasable long term storage media once every 30 days periodically for long term storage. Provision shall be made to notify the operator when the hard disk is a certain percentage full.
- The data to be stored shall include alarm and event list, periodic plant data, and selected logs/reports.
- The system shall provide user friendly operator function to retrieve, and playback stored data on Single Line Diagram and Network Diagram for the time window which shall be configured in seconds or minutes by defining Start and End date and time.
- It shall be possible to have tabular and graphical trends of the stored data.
- It shall be possible to set a different sampling rate for playback than the sampling rate for data storage.
- The users shall be able to select the time window of interest for archival of data in the ISR system for future retrieval and playback in EMS system.
- The Vendor shall give calculation of hard disk size required to store all analog data at 1 sec interval and digital data including alarm, event and trends for 3 years. Supply of such capacity hard disk shall be supplied by vendor / contractor.

- For long term plant performance analysis, the following plant data as minimum with time stamping and interval as indicated in table below but not limited to shall be stored on historian.

S. No.	Parameter	Time Interval
1.	Power Conditioning System (PCSs): DC Voltage, DC Power, DC Current, AC Active Power, AC Reactive Power, Power Factor, AC Current & Voltage, Energy, PCS Room Temperature, PCS Cabinet Temperature.	1 (One) Minute
2.	MFM, Energy meter and Numerical Relay data: Active & Reactive Power, Energy (Day), Current, Voltage	1 (One) Minute
3.	Export feeder/s Energy Meter Data: - Active & Reactive Power, Energy Import/Export, Current, Voltage, Grid Frequency.	1 (One) Minute
4.	Daily energy export from each PCS	24(Twenty-Four) Hours
5.	BESS Parameters for application functions: (i) Active & Reactive Power at grid feeders / BESS feeders (kV level) (ii) Reference Target Active & Reactive Power	1 (One) second
6.	VRFB Battery Parameters: Battery (Electrolyte/Stack) Voltage, SOC based on electrolyte chemistry / stack voltage, electrolyte temperature, stack temperature, flow rate, tank levels, pump status, leak detection, and other Battery Controller data.	1(One) Second
7.	Any other parameters as mutually agreed between Bidder / Consultant / Owner	As applicable

5.5.0 BESS CONTROL

- System shall have the capability to operate the BESS in Auto and Manual Mode. Activate local control of BESS, modify charge/discharge set points and ramp-up and down rates.
- BESS shall be operated either in Auto or Manual mode.
- During Manual Mode the following functions shall be allowed:

  a) Operator shall be able to provide grid power set point to EMS Controller through Centralized or local/Site EMS Controller. BESS shall charge/discharge the power within the band of reference target power.

  b) Operator shall be able to configure ramp-up and ramp-down rates of the BESS power (up to BESS maximum rating) by providing the set point to EMS Controller.

  - BESS shall remain in the designated input/output level until terminated by operator through centralized system or battery charging and discharging limit is reached.
  - EMS shall operate to manage the BESS component operating parameters within specified range as per applicable technical and industry/OEM standards in Auto mode.

- BESS operation shall be controlled through EMS HMI located at Main Control Room.
- The Control features in the EMS at the Main Control Room shall be customizable.
- EMS shall have Emergency SWITCH OFF provision (Single click with warning) to deenergize /disconnect the DC Block or entire plant during any emergency.

5.6.0 USE CASES

- Bidder to note that the supplied EMS system, including hardware and software shall be capable for following (not limited to) use case:

  a) Power Quality – Use storage to provide a high level of power quality like power factor compensation, voltage support, frequency support, phase balancing etc.

  b) Voltage Regulation – BESS shall support voltage regulation feature thereby maintaining the voltage at grid point within acceptable range to ensure that both real and reactive power production are matched with demand. Operator shall be able to provide reactive power/power factor set point to Controller through Centralized EMS. The VAR output may be limited based on the remaining capacity left after providing real power output.

  c) Peak Demand Management, Peak Shaving/Load Levelling – System shall be configurable, operate in Auto mode to store the power during light load and inject power back into grid during high demand.

  d) Emergency backup and Islanding Scheme – In the event of grid failure, battery energy storage shall island from the grid and cater the electricity requirement of load, critical load connected on BESS Switchgear Panel without any manual intervention. System shall manage and operate the load/critical load depending upon BESS operating parameters in island mode. BESS shall set and automatically control the voltage and frequency within acceptable limit. BESS shall have all the required hardware, control and protection features for safe operation of islanding scheme/micro-grid.

  e) Automatic change over between grid tied and off grid at full load during operation. The transition between On-grid and Off-grid state of operation shall be without any disturbance to loads. The transition shall be smooth.

  f) Manage Grid Point Import / Export – System shall manage the power injection/drawl at grid point by balancing the demand Vs generation of power.

  g) Deviation Settlement Mechanism (DSM) – System shall be configurable to manage DSM scenarios where BESS shall support to minimize the gap between scheduled Vs Actual demand by drawing the power from grid during underdrawer scenario and inject into grid during over drawl scenario. System shall have capability to operate in manual and auto mode to manage the drawl or injection in terms of quality and time based upon the gap between scheduled Vs actual demand of OWNER, Grid Frequency, IEX rate, DSM rate. OWNER allowable deviation at particular time slot to minimize penalty and maximize incentive under deviation settlement mechanism.

h) Power Purchase Optimize – System shall be configurable and operate in Auto/Manual Mode to store the power during Surplus Power Position and inject the power back into the grid during shortfall scenario. System shall be able to configure its drawl or injection

i) Black Start – System shall support black start operation of BESS and shall be of Grid forming type.

j) EMS shall Monitor following but not limited to critical parameters, alarms & Events of BESS Components

   i. PCS – Active, Reactive Power, Status, Black Start Status etc.

   ii. Battery (VRFB Controller) – Output Voltage, SoC, Electrolyte health indicators (vanadium balance, pH), Electrolyte Temperature, Total Energy, Battery Status, DoD, charging/discharging current, anolyte and catholyte flow rate, Anolyte and Catholyte level checks, Pump, Cell Stack (Temperature) etc.

   iii. BESS Mode - Automatic Mode (Normal Charge / Discharge, Grid Connected /islanded mode) and Manual Mode (Normal Charge / Discharge, Force Charge / Discharge, Grid Connected /islanded mode).

   iv. Health of Battery System – Usage of power, Temperature Scanning System (Electrolyte and Stack Temperature), Status, Alarms, Pressure etc.

   v. Health of Fire Alarm System (if applicable).

   vi. Switchgear Panel – Breaker Status, Relay Status / Measurands

   vii. Multi-winding Transformers – Winding and Oil Temperatures, Transformer health parameters, Relay Status

   viii. Auxiliary Power System (as applicable) – Status & Measurands of Battery Chargers, UPS, Battery and Distribution Boards

k) EMS shall have following but not limited Control functions of BESS Components

   i. SoC % - Configure SOC level & factor level (Configure SOC limits and operating levels based on VRFB electrolyte chemistry and stack voltage.

   ii. Leaks in either of the tanks, by signals from Leak detector for each tank (Detect and alarm electrolyte leaks from anolyte and catholyte tanks through dedicated leak sensors for each tank)

   iii. Operation – Open / close breakers, change of operating modes, change control logic for applications, charging control, change of local / remote control etc.

iv. Protection: Protection relay parameter setting, configure / control alarm / tripping for various signals of BESS Components.

v. Single line diagram representation - Monitor & Control critical parameters of BESS & its Components using HMI. EMS shall display the SLD of BESS and its components in user friendly manner.

vi. Monitor electrolyte temperature (anolyte and catholyte), stack temperature, and container ambient temperature.

vii. Monitor & Control BESS Plant Operation –
- Plant Operation Mode (Local / Remote)
- Grid Status (Connected / Disconnected)
- Enable / Disable – Use case modes like Active Power Control, Peak Shaving Control, Active Power Ramp, Reactive Power Control, SOC Stabilizer Control, Black Start, Voltage Regulation, Zero Export to Grid etc.

l) EMS shall be programmed for Micro grid functionality i.e. The MicroGrid Controller allows the ESS to run in synchronization with the grid and in case of grid failure it allows the ESS to run in off-grid mode or island mode (i.e., form its own grid). EMS, in case of grid failure, shall create its own grid by isolating Utility grid.

m) Other Use cases: EMS shall have features such as Grid voltage threshold-based dispatch, Wholesale price threshold-based dispatch, aggerating capacity across multiple BESS for open access and ancillary services (SRAS) in future.

n) The following signals shall be communicated with the Load Dispatch Center/Grid Substation:

Sr.No	Description	Signal Status	
A	Active Power Control Mode(APCM)	Status (Enable/Disable)	Digital
1	Active Power Reference (MW_ref)	Value (in MW at PPC bus)	Soft signal
2	Active Power Actual (MW_act)	Value (in MW at PPC bus)	Soft signal
3	Active Power Available (MW_avail)	Value (in MW at PPC bus)	Soft signal
B	Reactive Power Control Mode(RPCM)	Status (Enable/Disable)	Digital
1	Reactive Power Reference (MVAR_ref)	Value (in MVAR at PPC bus)	Soft signal
2	Reactive Power Actual (MVAR_act)	Value (in MVAR at PPC bus)	Soft signal
3	Available reactive power (for absorption)	Value in MVAR	Soft signal
4	Available reactive power	Value in MVAR	Soft signal

Sr.No	Description	Signal Status	
	(for injection)		
C	LVRT (Low Voltage Ride Through)	Triggering Alarm (in SoE)	Digital
D	HVRT (High Voltage Ride Through)	Triggering Alarm (in SoE)	Digital
E	Frequency Control Mode (FCM)	Status (Enable/Disable)	Digital
1	Droop Set	Value (Setting Value in %)	Soft signal
2	Frequency Deadband Set	Value (Setting Value max in Hz)	Soft signal
3	Frequency Deadband Set	Value (Setting Value min in Hz)	Soft signal

o) The following signals shall be communicated from the BESS SCADA System:

S. No.	From	To	Data and control Signal
a.	Grid Substation/LDC	BESS SCADA	MW & MVAR Set point.
b.	BESS SCADA	Grid Substation/LDC	MW, MVAR, Voltage, Frequency, OLTC tap, Breaker Status and other data as required by SLDC/RLDC.
c.	BESS SCADA	Field RTU of each block in the VRFB Plant	MW & MVAR Set point, time Sync signal
d.	Field RTU of each block in the VRFB Plant	BESS SCADA	MW, MVAR, Voltage, Frequency, Breaker status, Maintenance Schedule, State of Charge of each cell in , State
e.	BESS SCADA	Owner Remote Access System (if applicable)	Voltage, frequency, MW, MVAr, MWH, MVArH, power factor, Aux Power Consumption, System Down time, Performance data etc.
f.	Energy metering system	BESS SCADA	MW, MVAr, PF, MWH, MVArh, Frequency etc.
g.	Fire alarm System	BESS SCADA	Status of detectors, alarm and event, Status of Power supply and other data
h.	UPS	BESS SCADA	All analog and digital signal as finalized during detailed engineering
i.	Battery charger	BESS SCADA	All analog and digital signal as

S. No.	From	To	Data and control Signal
			finalized during detailed engineering

- Other functional requirements are provided below:
  a) Remote Data base downloading, diagnostic and configuration
  b) Information Storage and Retrieval
  c) Real Time stamping for all events and recordings
  d) Controlling Battery System Charge/discharge cycle and responding to Grid Condition
  e) Closed Loop (Auto) and User Control (Manual)
  f) Reactive Control (Q Control, Setting Point of reactive Power Q)
  g) Power Factor Control (PF Control, setting point of cos(L))
  h) Voltage Control (V Closed Loop Control, Setting point of V)
  i) Voltage Droop (Reactive Power vs Voltage programmable curve or droop)
  j) Apparent Power Control (S Lim, setting point of S Lim)
  k) Active Power Limitation (P Lim, setting point of P Lim)
  l) Power Ramp Rate Control (setting point of maximum %Pn/min)
  m) Frequency Regulation (Power vs Frequency programmable curve or droop)

6.0.0 CYBER SECURITY

Cyber Security Compliance

The EMS / SCADA / BESS system for the GIPCL – Gujarat Project shall be designed, supplied, installed, tested, and commissioned in compliance with applicable cyber-security guidelines and regulations issued by statutory and regulatory authorities, including but not limited to the following:

- CEA Cyber Security in Power Sector Guidelines (latest revision)
- Applicable provisions of the Indian Electricity Grid Code (IEGC)
- CERT-In cyber-security advisories, directions, and notifications, as applicable
- Relevant IEC / ISO cyber-security standards, such as IEC 62443 and ISO/IEC 27001, wherever applicable to the scope of the system
  The system architecture shall incorporate appropriate cyber-security controls, including but not limited to:
- Network segmentation and zoning
- Role-based access control
- Secure authentication mechanisms
- System logging and event monitoring
- Patch and vulnerability management

- Secure local and remote access mechanisms

Method of Certification / Compliance Declaration

Compliance with the above cyber-security requirements shall be demonstrated through one or more of the following methods, as applicable to the supplied system and as required by GIPCL:

1. OEM / System Integrator Self-Certification
The OEM and/or System Integrator shall submit a formal self-certification declaring compliance with the applicable cyber-security guidelines, standards, and best practices.

2. Third-Party Certification / Assessment (Where Applicable)
Where specified by GIPCL or mandated by applicable regulations, certification or assessment reports from recognized and accredited agencies (such as ISO/IEC 27001 or IEC 62443 certification bodies) shall be provided.

3. Cyber-Security Audit and Compliance Report
A cyber-security audit and compliance report covering system architecture, network design, access control, incident handling, patch management, and system hardening shall be submitted prior to commissioning or as required by GIPCL.

4. Authority-Specific Submissions
Any cyber-security compliance documentation, declarations, or data required by statutory or regulatory authorities applicable to the GIPCL – Gujarat Project shall be submitted by the Contractor, including but not limited to:

- Central Electricity Authority (CEA)
- Gujarat Energy Transmission Corporation Limited (GETCO)
- Gujarat State Load Dispatch Centre (SLDC)

.
However, if regulatory requirements or grid connectivity change in future, the Contractor shall comply with the applicable authority requirements accordingly.

Final Acceptance
Final acceptance of the EMS / SCADA / BESS system by GIPCL shall be subject to submission and approval of the applicable cyber-security compliance documents and certifications, in accordance with project requirements and prevailing regulations.

The Bidder shall comply with all applicable cyber security regulations, guidelines, and statutory requirements as detailed below.

6.1.0 All systems, equipment, communication networks, and control architecture shall comply with the provisions of the Information Technology Act, 2000, and the National Cyber Security Policy, 2013, as amended from time to time. The design shall also fully adhere to the Central Electricity Authority (Cyber Security in Power Sector) Guidelines, 2021, and the latest Central Electricity Authority (Cyber Security in Power Sector) Regulations, including the forthcoming 2025 Regulations coming into force on April 6, 2026. These requirements ensure protection of critical infrastructure, secure data handling, implementation of security controls, OT–IT

segregation, cyber-incident response mechanisms, and adherence to Trusted Telecom procurement norms for all IT equipment used in the power sector.

6.2.0 Implementation of the National Critical Information Infrastructure Protection Centre (NCIIPC) Guidelines.

6.3.0 Implementation of guidelines and advisories issued by Computer Emergency Response Team (CERT India) and applicable Sectoral Computer Emergency Response Team (CERT); and compliance to the latest Central Electricity Authority (Cyber Security) Regulations.

6.4.0 The architecture for control system shall be designed with security such that it is important that the selection process ensures that the level of protection is commensurate with the business risk and the system security shall not rely on one single security measure for its defence. (Reference IEC/TR62351-10 Edition1.0 2012-10 Power systems management and associated information exchange –Data and communications security – Part 10: Security architecture guidelines).

6.5.0 There is hard isolation of OT (Operational Technology) system from any internet facing IT system.

6.6.0 If required only one OT system shall be provided with internet, and it shall be isolated from all OT zone and kept in separate room under control and security of Owner IT representative.

6.7.0 Internet/broadband connection and Communication channel security configuration shall be provided by the bidder.

6.8.0 Downloading/Uploading of any data/information from internet facing IT system shall be done only through an identifiable whitelisted device followed by scanning of both for any vulnerability/malware as per the SOP laid down by Owner IT policy team. And for all such activities digital logs shall be maintained and retained, under the custody of Owner IT team, for at least 6 months. The log shall be readily available to carry out any forensic analysis, if requested by law enforcing/ investigation agency.

6.9.0 List of whitelisted IP addresses for each firewall shall be provided, and each firewall shall be configured for allowing communication with the whitelisted IP addresses only.

6.10.0 Bidder shall leverage state-of-the-art cyber security technologies and relevant processes at multiple layers to mitigate the cyber securities risks.

6.11.0 The bidder shall identify and document the Electronic Security Perimeter(s) and all Access Points to the perimeter(s) as per IEC 62443 / IS16335 (as amended from time to time).

6.12.0 Bidder shall ensure that every Critical System resides within an Electronic Security Perimeter.

6.13.0 Bidder shall perform a cyber-Vulnerability Assessment of each electronic Access Points to the Electronic Security Perimeter(s). Bidder shall ensure that all vulnerabilities identified as a result of cyber–vulnerability Assessment shall be closed. If a Cyber Asset is found vulnerable to any exploits or upon any patch updates or major configuration changes, then further Penetration Testing may be carried out offline or in a suitably configured laboratory testbed to

determine other vulnerabilities that may have not been identified so far. Bidder shall submit the report to Owner.

6.14.0 System supplied by bidder shall be provided with Intrusion Detection feature and Intrusion Prevention facility, capable of identifying behavioural anomaly in both IT as well as OT Systems. Bidder shall share reports on incident response and targeted malware samples Owner.

6.15.0 All Firmware/Software with digital sign of OEM shall only be updated in the system.

6.16.0 The system shall have 6 (six) month firewall log. Firewall log shall be analysed, and all critical high severity comments shall be closed immediately.

6.17.0 System shall maintain all cyber logs and cyber forensic records of any incident at least 90 days from the date of the commissioning of the system/recovery from any incident, whichever is later.

6.18.0 Bidder shall ensure that all the Communicable Intelligent Equipment and the Service Level Agreements (SLAs) for their Critical Systems shall be sourced from the list of the "Trusted Sources" as and when drawn by MoP/CEA.

6.19.0 Bidder shall ensure that, in case, for any Communicable Intelligent Devices, if no Trusted Source has been identified, then it shall have compliance with the provisions made in MoP order dated 2.7.2020 and any other relevant MoP order has got the product cyber tested for any kind of embedded malware/Trojan/cyber threat and for adherence to Indian Standards at the designated lab.

6.20.0 Bidder shall ensure that all Cyber Assets being procured shall conform to the type tests as mentioned in the specification for type testing listed in the bid document.

6.21.0 Type test reports of tests conducted in NABL accredited Labs or internationally accredited labs (with in last 5 years from the date of bid opening) shall be mandated to be submitted along with bid. Incase the submitted Type Test reports are not as per specification, the re-tests shall be conducted without any cost implication to the Owner.

6.22.0 Bidder shall ensure that all Critical Systems designed with Open-Source Software are adequately cyber secured.

6.23.0 FAT and SAT must include comprehensive cyber security tests of the communicable component/equipment/system to be delivered at site. Bidder shall ensure that the essential cyber security tests are carried out successfully during FAT and SAT. The equipment/System besides functionality shall also be tested in the factory for vulnerabilities, design flaws, parts being counterfeit or tainted, to minimize problems during on-site testing and installation.

6.24.0 Bidder to submit Vulnerability and Pen Test (VAPT) certificate for OWNER's team for Cyber clearance.

6.25.0 Bidder to submit IEC 62443-4-1 and IEC 62443-4-2 certificates to OWNER's for offered hardware and software.

6.26.0 Define security levels as per IEC 62443-3-3

6.27.0 Categorize systems and components into different security levels, specifying requirements for each level.

6.28.0 Justification for security level assignments based on risk assessment findings.

6.29.0 Clear definition of roles and responsibilities regarding cyber security for all stakeholders.

6.30.0 Appointment of a dedicated Cyber Security Officer (CSO) or responsible to oversee implementation.

6.31.0 The Responsible Entity shall ensure that Cyber Security training program designed for Owner must include following topics and as per their functional requirements and security concerns additional topics shall be added

6.32.0 User authentication and authorization.

- Cyber Security and Protection mechanisms of IT/OT/ICS Systems.
- Introduction to various standards i.e. ISO/IEC:15408, ISO/IEC:24748-1, ISO: 27001, ISO: 27002, ISO 27019, IS 16335, IEC/ISO:62443.
- Training on implementation of ISO/IEC 27001 and awareness on IEC 62443.
- Vulnerability Assessment in the Critical System.
- Monitoring and preserving electronic logs of access of Critical Assets.
- Detecting cyber-attacks on SCADA and ICS systems
- The handling of Critical System during cyber crisis.
- Action plans and procedures to recover or re-establish normal functioning of Critical Assets and access thereto following a Cyber Security Incident.
- Hands on SCADA operation at any of the Regional Load Dispatch Centre.
- Handling of risks involved in the procurement of COTS Products.

6.33.0 The standards and codes of practice for Wideband network shall be follow as per the "Technical Standards for Communication System in Power System Operation, Schedule II" are listed below:

- Transmission quality shall be as per ITU-T G.821, G.823, G.826
- Terminal equipment shall be designed as per ITU-T G.783
- Optical interface shall be FC-PC and shall be as per ITU-T G.957, G.958
- Wideband communication (wideband network) shall be optical interface LC (Lucent Connector) conforming to IEC 61754-20 (part 20)
- Network synchronization shall be as per ITU-T G.813
- Management Functions shall be as per ITU-T G.774, G.784
- Protection architecture shall be as per ITU-T G.841
- Built-in testing and Alarm shall be as per ITU-T G.774, G.783, G.784

- The link performance for ES, SES and BER for the fiber optic links shall correspond to National Network as defined in ITU-T G.826

6.34.0 GIPCL is having own CSO, and the bidder has to appoint representative responsible for overall system for cyber security related to all compliances.

7.0.0 TECHNICAL SPECIFICATIONS

7.1.0 EMS CONTROLLER

7.2.0 Bidder shall supply the EMS controller, server and SCADA with the latest hardware and software version which shall support charging and discharging, safety and grid regulated parameters, demand response, renewable integration and real time monitoring and other required applications mentioned in this specification there of or being required for desired functioning of BESS.

7.3.0 EMS Controllers shall be best in class and advanced in respect to the parameters listed below (not limited to)

- **LOCAL/FIELD CONTROLLER**

Specification	Details
Make and Model Number	Bidder to Specify
Processor	High Performance Industrial Grade CPU
Loading	Shall not exceed 40% under peak load
Redundancy	Not Required
Communication Card	Required (non-redundant)
Power Supply	Required
Memory	Minimum 16 GB RAM and minimum 1 TB industrial-grade SSD for logging, buffering, and analytics
Power Connection	230V AC (UPS)
Input Output Modules	Required (Quantity shall be per requirement including spares)
Communication Port	RS485 (MODBUS RTU), MODBUS TCP/IP, DNP3, IEC 61850, USB, Serial Interface for Custom Integration
Operating Temperature	-40 to 70 Deg C
Mounting	Inside Rack/Panel mounted in Field
Corrosion Class	C4 M
Conformal Coating	G2
Certification	CE, UL, EN

- **CENTRAL CONTROLLER**

Specification	Details
Make and Model Number	Bidder to Specify
Processor	High Performance Industrial Grade CPU
Loading	Shall not exceed 40% under peak load

Specification	Details
Redundancy	Required (Redundant)
Communication Card	Required (Required)
Power Supply	Required (Redundant)
Memory	Minimum 16 GB RAM and minimum 1 TB industrial-grade SSD for logging, buffering, and analytics
Power Connection	230V AC (UPS)
Input Output Modules	Required (Quantity shall be per requirement including spares)
Communication Port	RS485 (MODBUS RTU), MODBUS TCP/IP, DNP3, IEC 61850, USB, Serial Interface for Custom Integration
Mounting	Inside Rack/Panel located in Central Control Room
Operating Temperature	-40 to 70 Deg C
Corrosion Class	C4 M
Conformal Coating	G2
Certification	CE, UL, EN

7.4.0 PPC CONTROLLER

- The PPC system and equipment's installation, monitoring, contorting operation & maintenance must meet relative IEC, India grid code standards & meet latest CEA/ CERC/ POSOCO guideline and amendment.
- The PPC system for VRFB plant project shall be composed of an integrated human-machine interface (HMI), controller, input/output (I/O) cards, media converters, remote terminal units (RTU), Fiber optical terminal equipment, LIU, communication infrastructure and software etc.
- The PPC is the main control system responsible of generating control reference in order to manage the power flow at the point of interconnection (POI).
- This device performs different types of control of both active and reactive power as well as commands the devices of the plant.
- The PPC communicates with the Central EMS Controller, the VRFB Plant and the existing DCS, according to the needs of the plant. The PPC also controls the Central EMS Controller, through providing setpoints.
- The PPC is the main control system responsible of generating control reference in order to manage the power flow at the point of interconnection (POI).
- Power curtailment as per Grid requirement and set point shall be provided.
- The PPC shall be capable of communicating through IEC 104, to the LDC/Grid Substation.
- PPC shall be capable of Measuring and processing of the electrical magnitudes at Grid Point of Injection (voltage, current, PF, active and reactive power)
- Power Plant Controller monitors grid and selects the optimum operating mode of the whole VRFB plant thus controlling the active and reactive power exchange to grid,

based on grid voltage and frequency. Additionally, it can receive external set points and will automatically adapt the Plant behavior to the new settings.

- Power Plant Controller allows the following operational modes:
    a) Reactive Control
    b) Power Factor Control
    c) Voltage Control
    d) Apparent Power Control
    e) Active Power Limitation
    f) Power Ramp Rate Control
    g) Frequency Control

- Power Plant Controller can receive the target values specified by grid operators using a standard protocol (i.e. Modbus TCP/IP, DNP3, IEC 61850,101/104) and over different communication media (as a general guideline, optical fiber in case of long distances.

7.5.0 SERVERS

- The server(s) shall be provided with provision for future scalability.
- If any additional hardware or peripheral devices required during commissioning for successful installation of system shall be provided by Bidder without any cost implication.
- Servers shall be cyber security compliant as per CEA latest guidelines.
- The following table is the minimum requirement, and the bidder shall provide based on current technologies, market availability and Owner's requirements.

Specification	Details
Make and Model Number	Bidder to Specify
Enclosure	6U Rack mountable server/Tower type server
Processor	Intel Xeon 64 Bit Process (Latest Processor shall be offered by Bidder) (Industrial Grade)
Memory	64GB DDR (Minimum)
Drivers	HDD – RAID 5 (1TB) Ultra 320 SCSI adaptor with internal storage capacity of minimum 3.6 TB
USB	04 Number of Ports 10/100/1000Mbps
Operating System	Latest and Proven version of Windows server operating system
Temperature	0 to 70 Deg C
Software	MS Windows latest, MS Office Editor, Adobe, Acrobat, Anti-Virus McAfee or equivalent, AUTOCAD, Network security, Application engineering and HMI software.

7.6.0 SCADA HMI

- The EMS SCADA shall be located in Main Control Room. It shall consist of Operator Workstation, Engineering Workstation and Historian.
- Workstation shall be based on the latest state of art technology. The workstation employed shall be redundant based on industry standard hardware and software which will ensure easy connectivity with other systems and portability with third party software.
- The LAN provided shall support TCP/IP protocol (Ethernet connectivity) for interface with other system and shall have data communication speed of minimum 100Mbps.
- All network components of LAN and Workstation shall be compatible with the LAN, without degrading its performance. Each operating station and Engineering Workstation shall meet the following minimum requirements and as per the latest trends at the time of supply:
    a) HMI shall be provided with antiglare hard coating. High reliability and long-life monitors shall be provided. Monitors shall be equipped with all adjusting elements accessible on the front plate.
    b) All Monitors shall be of high-resolution color graphics type and with not less than 32 colors.
    c) HMI shall be minimum 32" (diagonal) LED Flat Monitor with non-interface refresh rate minimum 75Hz.

7.7.0 FIREWALL

- Bidder to note that the Energy Management System is required to be interfaced with external environment through Fire Walls.
- The firewall shall consist of Enterprise Protection and OT security service license. The communication network shall have the possibility of adopting "open architecture" to enable the user to get the benefit of flexibility in choosing hardware & software. Network shall also be provided with external surge protection system and industrial Next Generation Firewall (NGFW).
    a) All ethernet based applications shall be terminated in the firewall ports directly. Each port of firewall shall work as a separate zone. Firewall shall be hardware based with functionality of Block/Allow/drop and IPSec VPN (network encryption).
    b) Minimum 16 Nos. of ports/interfaces shall be provided in each firewall (i.e. Main & Standby) Owner can use either single firewall or multiple firewalls to meet this interfaces requirement, each for main as well as standby firewall. Minimum throughput of firewall shall be 300 Mbps.
    c) The Firewall shall be managed/ configured as standalone at present and shall also have compatibility to manage/configure through Centralized Management Console (CMC) remotely in future.
    d) Firewall shall be tested and certified for ISO15408 Common Criteria for least EAL4+. Further, the OEM must certify that it conforms to Secure Product

Development Life Cycle requirements as per IEC62443-4-1. The firewall shall generate reports for NERC-CIP Compliance.

e) NGFW shall have following features including but not limited to: Encryption through IPSec VPN (Virtual Private Network), Deep Packet Inspection (DPI), Denial of service (DoS) & Distributed Denial of Service (DDoS) prevention, Port Block/ Allow, rules/ policies for block/allow, IP (Internet Protocol) & Media Access Control (MAC) spoofing protection, threat detection, Intrusion Prevention System (IPS), Anti-Virus, Anti-Spyware, Man In The Middle (MITM) attack prevention.

f) The proposed firewall shall be able to handle (alert, block or allow) unknown unidentified applications e.g. unknown TCP & UDP packets. It shall have the provision to define application control list based on application group and/or list.

g) Firewall shall have feature and also have capability to update the definition/ Signatures of Anti-Virus online as well as offline. Firewall shall also be compatible to update the definitions/signatures through CMC. There shall be a defined process for security patching and firmware up-gradation. There shall be a feature to field validate firmware checksum. The same shall also be validated before using the OEM provided file/binary in the process of firmware up-gradation and security patching.

h) Firewall shall have Management Console port to configure remotely.

i) Firewall shall be EMI/EMC compliant in Substation environment as per IEC 61850-3.

j) Firewall shall be rack mounted in existing standard equipment cabinets.

k) Firewall shall have support of SCADA applications (IEC-60870-5-104), ICCP, PMU (IEEE C37.118), Sub-Station Automation System (IEC 61850), Ethernet and other substation environment protocols.

l) Client-based Encryption/ VPN must support different Operating System platforms e.g. Windows, Linux & Mac.

m) The solution must have content and comprehensive file detection policies, blocking the files as function of their types, protocols and directions.

n) Firewall shall have logging facility as per standard logs/events format. Firewall shall have features to export the generated/stored logs/events in csv (Comma Separated Value) and also any other standard formats for offline usage, analysis and compliance. Firewall shall have suitable memory architecture and solution to store and be enable to export all logs/events for a period of last 90 days at any given time.

o) Firewall shall have features and be compatible with local as well as central authentication system (RADIUS, LDAP, or TACACS+) for user account and access right management. It shall also have Role Based User management feature.

p) Firewall shall have the capability to configure sufficient number of VLANs.

q) Firewall shall have the capability to support sufficient number of sessions.

r) Firewall shall have provision to configure multiple IP Sec VPNs, at least 100 nos., (one-to-many or many-to-one). Shall support redundant operation with a similar router after creation of all the IP Sec VPN. IPSec VPN shall support encryption protocols as AES128, AES256 and hashing algorithms as MD5 and SHA1. IPSec VPN throughput shall support at least 300 Mbps.

s) Firewall shall be capable of SNMP v3 for monitoring from Network Management system. It shall also have SNMPv3 encrypted authentication and access security.

t) Firewall shall support in Active/Passive or Active-Active mode with High Availability features like load balancing, failover for firewall and IPsec VPN without losing the session connectivity.

u) Firewall should have integrated traffic shaping (bandwidth, allocation, prioritisation, etc.) functionality.

v) Firewall shall support simultaneous operation with both IPv4 and IPv6 traffic.

w) Firewall shall be compatible with SNTP/NTP or any other standards for clock synchronization.

x) Firewall shall have the features of port as well as MAC based security.

y) Firewall shall support exporting of logs to a centralized log management system (e.g. syslog) for security event and information management.

z) Firewall time shall be kept synchronised to official Indian Timekeeping agency, time.nplindia.org.

aa) Firewall product shall be provided with all applicable updates at least until 36 months since the applicable date of product shipping to the concerned utility.

7.8.0 ANTI-VIRUS SOFTWARE

- It is recommended that bidder shall consider below antivirus to all servers/workstation etc.
- Bidder to provide the subscription license valid for 3 years and Software Support.
- This AV require for number of SCADA/OWS/EWS/Historian server. So, Quantity will be based on no of windows servers.

7.9.0 INPUT OUTPUT MODULES

- The SCADA system should be designed according to the location of the input/output cabinets as specified.
- Input Output modules, as required in the Control System for all type of field input signals (4-20 mA, non-changeover/change over type of contact inputs etc.) and outputs from the control system (non-changeover/change over type of contact, output signals for energizing interface relays at suitable DC voltage as decided during detail engineering, 4-20 mA output etc.) are to be provided by the Contractor.
- Electrical isolation of 1.5kV with optical couplers between the plant input/output and controller shall be provided on the I/O cards. The isolation shall ensure that any

inadvertent voltage or voltage spikes (as may be encountered in a plant of this nature) shall not damage or maloperation the internal processing equipment.

- The Input/output system shall facilitate modular expansion in fixed stages. The individual input/output cards shall incorporate indications on the module front panels for displaying individual signal status.
- Individually fused output circuits with the blower fuse indicator shall be provided. All input/output points shall be provided with status indicator.
- The I/O Module shall have the following features:
    a. Power supply monitoring
    b. Contact bounce filtering
    c. Optical isolation between input and output signals with internal circuits.
    d. In case of power supply failure or hardware fault, the critical outputs shall be automatically switched to the fail-safe mode. The fail-safe mode shall be finalized during detailed engineering.
- Binary Output modules shall be rated to switch ON/OFF coupling relays of approx. 3 VA. Analog output modules shall be able to drive a load impedance of 500 Ohms minimum.

7.10.0 SYSTEM SPARE CAPACITY

The EMS shall be designed so that after commissioning the following spare capacity shall be available:

Application		Remarks
Spare ports in Ethernet Switches	:	Ethernet switches shall be provided with 20% spare ports
Spare capacity in each controller	:	Each controller shall be equipped with the amount of functional capacity required to perform its specified functions and still have an overall spare capacity of 40%.
Installed Spare I/O Channels in each module	:	20% fully wired input/output spare channel should be provided for each I/O modules.
Installed Spare I/O module	:	20% spare I/O channels shall be provided in each I/O module. In addition to this 10% or minimum one no. extra assigned complete spare cards (whichever is more) fully wired mounted in the cabinets for each type of I/O modules shall also to be provided.
Additional module handling capacity	:	The EMS shall be provided with the capacity and capability to handle either 20% additional modules for each type of modules or 20% over and above the specified number of modules connected to the system bus without any additional hardware or software

Application		Remarks
		requirements. These additions shall not result in decrease in system response time (i.e. control response time, display response time, SOE resolutions etc.).
Spare relays & spare terminal blocks	:	20% spare relays of each type and rating, mounted and wired in relays cabinets. All contacts of relays shall be terminated in terminal blocks of relay cabinets, additionally in each of the relay cabinets, 20% spare terminal blocks shall be 'provided so that additional relays can be mounted and wired. i.e. All signals shall be wired through marshalling cabinet for all inputs, the spare terminals, fully wired up to marshalling cabinets are also to be provided.
Wired-in "usable" space	:	Wired-in "usable" space for 20% modules in each of the system cabinets for mounting electronic modules shall be provided by the bidder. Empty slots between individual modules/group of modules, kept for ease in maintenance or for heat dissipation requirement as per standard practice of Bidder shall not be considered as wired-in "usable" space for I/O modules. Field Terminal assemblies, PCB/ Connectors (if any in the offered system), corresponding to the I/O modules shall be provided for above-mentioned 20 % blank space.
Spare unused terminals	:	At least 20 percent of spare unused terminals shall be provided on each terminal block for circuit modifications and for termination of all conductors in a multi-conductor control cable with each panel.
Blank space	:	20% fully wired slot and additional 20% blank space in network panels.
Master clock signal	:	20% Spare in each type of protocol
Software license for all elements	:	30% above the implemented Tag
Hardwired I/O tag	:	30% above the implemented Tag

7.11.0 NETWORK/ETHERNET SWITCHES

- The Bidder shall supply Industrial-Grade Managed Ethernet Switches suitable for mission-critical EMS/SCADA communication networks used in utility-scale BESS installations. The switches shall ensure deterministic, low-latency, cyber-secure, and redundant communication across the EMS, PPC, SCADA servers, field controllers, and substations.
- Each switch shall meet or exceed the following minimum requirements:

Specification	Details
Make and Model Number	Bidder to specify (industrial-grade, proven field deployment)
Number of Ports	As required; minimum mix of Copper (RJ-45) and Fiber Optic SFP ports (Single-Mode)
Type of Fiber Cable	Single-Mode Fiber Optic (SMF) compliant with G.652D or equivalent
Ethernet Standard	IEEE 802 series compliance including 802.3, 802.3u, 802.3ab, 802.3z, 802.1Q (VLAN), 802.1p (QoS), and 802.1D/802.1w/802.1s for RSTP/MSTP
Switching Method	Store and forward
Layer Support	Minimum Layer-2 Managed; Layer-3 Lite preferable
Redundancy Protocols	Support for RSTP/MSTP; PRP/HSR desirable for EMS high-availability networks
Cybersecurity	Port Security, MAC filtering, RADIUS/TACACS+, HTTPS, SSH, SNMPv3
Reverse Polarity Protection	Required
Operating Temperature	–40°C to +70°C (industrial wide-temp grade)
Enclosure Rating	IP30 or higher suitable for control rooms and field panels
EMC/Surge Protection	Industrial EMC compliance; surge protection on all interfaces
Industrial Grade	Mandatory (ruggedized, vibration-resistant components)
Quality of Service (QoS)	Mandatory; 802.1p/DSCP traffic prioritization
Latency	Bidder to specify guaranteed switching latency under full load
Power Supply Input	24 VDC or 230 VAC (UPS-backed); redundant power supply
DIN-Rail or Rack Mounting	As required per installation location
Network Management	SNMPv3, Web GUI, CLI, Syslog, NTP synchronization
Diagnostics	Port mirroring, cable diagnostics, network monitoring tools
Security Logging	Event logging compatible with centralized EMS

Specification	Details
	cyber monitoring

7.12.0 LIGHT INTERFACE UNIT (LIU)

- LIU are generally used in interconnecting, cross connecting or splicing applications.
- The LIU is an Optical Fiber interconnecting unit.
- LIU shall help in efficient fiber management for maintenance.
- The number of ports expected shall be 6, 12 or 24 ports as per the location requirement.
- LIU shall help in efficient fiber management for maintenance. Also, patch chords shall be used on either end of the fiber cables.
- The Fiber optic cables shall be Single Mode FO cable across complete plant. Connectors and accessories shall be considered accordingly.
- Panels shall be C5 corrosion resistant.

7.13.0 PRINTER

- The Bidder shall supply a Color LaserJet Printer capable of printing both A3 and A4 size documents.
- The printer shall meet or exceed the following minimum technical requirements:

Specification	Details
Printer Type	Color LaserJet, A3/A4 capable
Print Speed	Minimum 25 ppm (A4) in color/mono
Print Resolution	Minimum 1200 × 1200 dpi
Memory	Minimum 512 MB built-in memory
Processor	High-performance printer processor (Bidder to specify)
Connectivity	1× USB 2.0 or higher, 1× Gigabit Ethernet (10/100/1000Base-T)
Duty Cycle	Minimum 50,000 pages/month
Paper Trays	Minimum 2 trays (A3/A4 support) + manual bypass tray
OS Compatibility	Windows Server / Windows OS versions used in EMS/SCADA systems
Print Language Support	PCL 5/6, PostScript, PDF Direct Print

Specification	Details
Display	LCD/Touch Display for operation
Power Requirements	230 VAC, 50 Hz

7.14.0 HMI DISPLAY

- The BESS SCADA shall process and synthesis the data collected and provide for Display manager, event manager, trend manager and other utilities residing in the Server. The SCADA shall facilitate OWS/EWS to display SLD, trend, Alarm and Events, Report page.
- The display selection process shall be optimized so that the desired display can be selected with minimum number of operations.
- Display requests shall have the following features:
    a) Selection of a display from a menu display
    b) Cursor target selection on any menu, graphics or tabular display
    c) Selection of event/alarm
    d) Option to switch the display in regular and full screen mode
    e) Selection of pictures/functions by using keyboard shortcuts
    f) It shall be possible to open upto 5 instances of application per operator login.
- Permeant Indicators Several indicators, including those listed below, shall be permanently shown on each EMS display screen as minimum:
    a) Date and time – Format shall be defined during execution phase of the project
    b) Username who logged in the system
    c) Name of display window Any other items which shall be necessary shall be finalized during detailed engineering or execution phase of the project.

7.15.0 POWER SUPPLIES FOR SCADA/EMS CONTROLLER

- The system AC power source wherever required shall be nominal 240 VAC, 50 Hz, single phase, ungrounded power supplied from parallel redundant un-interruptible power supply system (UPS) of the Bidder. This power supply system may be subject to a period of potential interruption of one cycle on 50 Hz basis which shall not lead to control system malfunction, process upsets or danger to main equipment being controlled by the system.
- All equipment requiring power from the system power source (UPS) shall not impose any ground connections on it. If ground connections are required by equipment design the Bidder shall provide isolation transformers to prevent transmission of these grounds to the system power source.

7.16.0 TRENDS

- Trends shall display of series of values of parameters on a time axis. Both graphical trends and tabular trends shall be possible. It shall be possible for users to drag and drop parameters to create trends. Multiple parameters with multiple axis shall be used to create trends as per user requirements. It should be possible to select the date and period of trend. It shall be possible to configure indication status in trend.
- Trends shall be available for instantaneous as well as for derived parameters like max, average apart from one minute, one hour, one day, one week or one Month.
- It shall be possible to highlight various flags like maximum, minimum, average value of the samples used for the trend, by using representation like base line, colored points on user settings used for the trend.
- It shall be possible to export the trends in into Image, pdf and excel format.

7.17.0 ALARMS

- All alarms shall be presented to the user in a consistent manner. Alarm condition shall include but not limited to the following:
    a) Telemetered or calculated value limit violations
    b) Alarming state of events.
    c) Un-commanded changes of a power system device state
    d) EMS application program results
    e) Data source communication errors resulting in loss of data
    f) EMS system hardware or software failures.
    g) System shall be able to block and flag out spurious alarms having rate more than the set limit as per user requirement.
    h) Alarm for gradient limit violations
- EMS system shall support alarm priority levels. It shall be possible to assign distinct audible and/or representation to each alarm priority level. There shall be a provision/flexibility to view different priority alarms in separate display as per user requirement. For each alarm, it shall be possible for the user to independently configure the following actions.
    a) Audible alarm tone type selection and its enabling/disabling
    b) Alarm messages to be displayed on an alarm summary
    c) Alarm message disappear from alarm summary when acknowledged (for non-persistent alarms)
    d) Alarm message disappear from alarm summary when return-to-normal alarm occurs
    e) Alarm message deleted from alarm summary when return-to-normal alarm is acknowledged.
    f) Alarm message deleted by user action.
- User Interaction for Alarms

a) The User shall be able to perform the alarm interactions described below

b) Alarm Inhibit/Enable

c) Alarm acknowledges

d) Audible alarm silencing

e) Change alarm limits

7.18.0 ALARM PRESENTATIONS

- Alarm presentation shall be determined by the alarm's category and priority. Displays shall highlight every alarm condition using a combination of colour, intensity, blinking and audible sound. The alarm condition highlighting shall show whether the alarm has been acknowledged.
- The highlighted alarm condition shall appear on all displays containing that device or value at all consoles regardless of the alarm's category. Alarm messages shall be a single line of text describing the alarm that has occurred and the time of occurrence. The alarm message shall be English text and shall not require the use of a reference document for interpretation.
- Provision to export alarm list in excel and pdf format shall be provided
- Provision to filter and sort shall be provided in EMS system based on Priority, station, device, time slot, console, operator etc. from any console.

7.19.0 EVENTS

- Events are conditions or actions that shall be recorded by the EMS system but do not require user action
    a) User initiated actions
    b) Conditions detected by application functions that do not require immediate user notification but should be recorded
- Events shall be recorded in the form of an event message. The event message format shall be similar to the alarm message format. The same message format shall be used for displaying and printing events. Event messages shall be displayed on an events summary.
- Provision to filter and sort shall be provided in EMS system based on Priority, station, device, time slot, console, operator etc. from any console. Provision to export event list in excel and pdf format shall be provided.

7.20.0 DISPLAY TYPES

- Bidder shall provide the following but not limited display type in EMS Solution. The same shall be submitted for OWNER's review and approval during detailed engineering.
    a) BESS network / schematic
    b) Single line diagram
    c) BESS overview tabular
    d) Alarm Summary display
    e) Event summary display
    f) Manual override summary
    g) Off normal summary
    h) Out of scan summary
    i) Alarm inhibit summary
    j) Tag Summary
    k) Tabular trending summary
    l) Notes
    m) BESS Communication channel monitoring and control
    n) EMS application display
    o) Help

7.21.0 EARTHING

- Earthing system shall be designed based on system fault current and soil resistivity value obtained from geo-technical investigation report. Earth grids shall be formed consisting of number of earth electrodes sufficient enough to dissipate the system fault current interconnected by earthing conductors.
- All metal parts such as panels, junction boxes, racks, enclosures etc. shall be earthed into a safety grounding system.

7.22.0 POWER QUALITY METER

- Power Quality Meter will be free supply to Bidder.
    i. It shall have a facility for time synchronization on the NTP protocol from the GPS clock.
    ii. It shall be able to communicate with PPC on Modbus TCP/IP protocol
    iii. All associated software to be supplied for configuration, monitoring & maintenance of PQM to be installed on the EWS cum OWS.

7.23.0 TESTING AND DOCUMENTATION

- This section describes the specific requirements for testing and documentation of the EMS system.
- Type Testing – Type test reports of tests conducted in NABL accredited Labs or Internationally accredited labs within last 5 years from the date of bid opening may be submitted. In case the submitted reports are not per specification, the type tests shall be conducted without any cost implication to OWNER.

7.24.0 FACTORY ACCEPTANCE TEST (FAT)

- EMS system shall be tested at the bidder's facility. All hardware and software associated with the EMS system shall be staged for the factory testing.
- The requirements for exchanging data with other computer systems like SCADA for set point shall also be simulated.
- Each of the factory tests described below (i.e. the hardware integration test, the functional performance test, integrated system test and unstructured tests) shall be carried out under factory test for the EMS system.

HARDWARE INTEGRATION TEST

- The hardware integration test shall be performed to ensure that the offered computer hardware, conforms to this Specification requirements and the Contractor-supplied hardware documentation. All the EMS system hardware shall be integrated and staged for testing. Applicable hardware diagnostics shall be used to verify the hardware configuration of each equipment. The complete hardware & software bill of quantity including software licenses & deliverables on electronic media shall also be verified.

FUNCTIONAL PERFORMANCE TEST

- The functional performance test shall verify all features of the EMS hardware and software. As a minimum, the following tests shall be included in the functional performance test:

  a) Testing of the proper functioning of all EMS & other software application software in line with the requirements of various sections of this specification document.

  b) Simulation of field inputs from test panels that allow sample inputs to be varied over the entire input range.

  c) Simulation of field input error and failure conditions.

  d) Simulation of all type of sample control outputs

  e) Verification of communication Protocol

  f) Simulation of CIM/XML based data exchange between EMS and other third-party applications.

  g) Verification of Data Integration from EMS system to other IT systems etc., if required

  h) Verification of interoperability profile of all profiles of all protocols being used.

i) Verification of RTU /Controller communication interfaces.

j) Verification of LAN and WAN interfaces with other computer systems

k) Testing of all user interface functions, including random tests to verify correct database linkages

l) Simulation of hardware failures and input power failures to verify the reaction of the system to processor and device failure.

m) Demonstration of all features of the database, display, report generation and all other software maintenance features of system. Online database editing shall also be tested. Demonstration of the software utilities, libraries, and development tools.

n) Verification of system to check system meets or exceeds Owner's performance requirements (as per table for peak & normal loading in Design parameters)

o) Verification that ultimate expansion requirements are met

p) Verification of Development system

q) Unstructured testing of the EMS system by Owner. The unstructured tests shall include the test, which are not in the approved test procedures and may be required to verify the compliance with the specification.

7.25.0 SITE ACCEPTANCE TEST

- The EMS system shall be tested at the site. All hardware and software associated with the EMS system along with all connected devices viz RTUs/Controllers etc. shall be tested under the field tests.
- Field Functional Performance Test
- The field performance test shall concentrate on areas of EMS operations that were simulated or only partially tested in the factory (e.g., system timing and loading while communicating with a full complement of RTUs/Controllers and data links and system reaction to actual field measurements and field conditions). Further the validity of factory test results determined by calculation or extrapolation shall be examined. After the end-to-end test, the bidder shall conduct the field performance test to verify the functional performance of the system in line with the technical specification which includes the following:

  a) The communication of other system SCADA etc. with EMS system

  b) Verify that all the variances observed during the Factory test are fixed and implemented.

  c) Conduction of the Factory tests deferred (tests requiring site environment)

  d) Functional tests of EMS system

  e) Verify the execution rates of all EMS application

  f) Verify update rate & time for data update & control command execution as per specification requirements

  g) Verify the response time of all EMS applications.

h) Verify the response time for User interface requirements Testing of all features of the database, display, and report generation and all other software maintenance features on cloud.

i) Online database editing shall also be tested.

j) Conduction of unstructured tests as decided by the Owner

k) Verification of RTU /Controller communication Protocol

l) Verification of Data Integration from EMS system other systems over Open Standards

m) Verification of interoperability profile of all profiles of all protocols being used.

n) Verification of RTU /Controller communication interfaces

o) Verification of LAN and WAN interfaces with other computer systems

p) Testing of all user interface functions, including random tests to verify correct database linkages

q) Simulation of hardware failures and input power failures to verify the reaction of the system to processor and device failure

r) Demonstration of all features of the database, display, and report generation and all other software maintenance features on the system. Online database editing shall also be tested on the system.

s) Demonstration of the software utilities, libraries, and development tools.

t) Verification that the EMS computer system meets or exceeds Owner's performance requirements

u) Verification that ultimate expansion requirements are met.

v) Verification of Development system

w) Verification of data transfer from main to back up EMS system

7.26.0 END TO END TEST

- After the field installation tests, the bidder shall carry out end-to-end test to verify:

a) The communication of RTUs/Controllers with EMS system

b) Communication channel monitoring in the EMS system

c) The mapping & point to point testing of EMS database with RTU /Controller database for all points.

d) The mapping of EMS database with displays and reports

e) The Bidder shall provide the details of all the variances observed and corrections carried out during the end-to-end test.

7.27.0 CONTINUOUS OPERATION TEST (48 HOURS)

- This test shall verify the stability of the EMS hardware and software after the functional performance test has been successfully completed.

- During the test, all EMS functions shall run concurrently, and all Contractor supplied equipment shall operate for a continuous 48 (forty-eight) hour period with simulated exchange with other interconnected system.
- The test procedure shall include periodic repetitions of the normal and peak loading scenarios defined. These activities to be tested may include, but shall not be limited to, database, display, and report modifications, configuration changes (including user-commanded processor and device failover).

7.28.0 COMMISSONING AND PRE-COMMISSIONING

- Bidder shall be responsible for pre-commissioning and commissioning of Energy Management System which includes interface between various third-party system.
- Bidder shall deploy their trained and skilled manpower at site for performing required activities per detailed schedule.
- All required important parameters shall be recorded during pre-commissioning and commissioning stage of the project.
- Bidder shall include all necessary mandatory spares in their proposal.
- Bidder shall indicate the tentative schedule for pre-commissioning and commissioning activities at time of proposal submission.

7.29.0 TRAINING

This section describes general requirements that apply to all training courses. The bidder shall submit the training proposal along with the bid. The training content, schedule and location shall be finalized during project execution.

Training shall be conducted by bidder's personnel, who are experienced instructors and speak understandable English.

All necessary training material shall be provided by the Contractor. Each trainee shall receive individual copies of all technical manuals and all other documents used for training.
The bidder shall include training cost in bid proposal; this shall not be limited to days and number of OWNER's personnel taking training.

The schedule, location, and detailed contents of each course will be finalized during Owner and bidder discussions in project kick-off or project engineering. The Owner shall review and approve the contents of the overall training prior to the start of the training.
Training Course Requirements - Owner's training course requirements are described below in terms of the contents of each course to be provided.

Operator Training Course for 5 Man-days

- This training course shall provide training to Owner's operators on EMS Systems so that operators can understand / manage the system effectively. The training shall include:

- System Overview: Configuration of the system, a functional overview, and an overview of system capabilities and performance.

- General Operating Procedures: Hierarchical structure of displays, display capabilities and features, user procedures, log-on and user access restrictions, and error messages.

- System Applications: Theory of operation, capabilities, and operating procedures for each application function.

- Handling of Equipment: Minor maintenance operations which do not require spares/specialized skills.

- Operator Documentation: Orientation of the organization and application of all user documentation for Operator and verification of the information contained therein.

- The course shall focus on hands-on training on the system.

- If required, different sessions shall require to be organized by Bidder.

EMS Application Software Course for 5 Man-days

The bidder shall provide training on Application software courses covering all EMS applications. The training shall include:

- Overview: Block diagrams of the application software and data flows. Programming standards and program interface conventions.

- Application Functions: Overview of Functional capabilities, design, and algorithms. Associated maintenance and expansion techniques.

- System Programming: An introduction to software architecture, Effect of tuning parameters (OS software, Network software, database software and Application Software etc.) on the performance of the system. Administration of Database (both real-time and RDBMS), Software Documentation: Orientation in the organization and use of system software and Application software documentation.

- Display building and Report generation

- EMS Architecture and Database system. How to identify database fields, entries, records, tables, and contents

- Hands-on Training: shall be provided with allocated computer time for trainee performance of unstructured exercises and with the course instructor available for assistance as necessary.

7.30.0 WARRANTY

The Bidder shall ensure Patch management shall be provided for all servers OS and SCADA software to ensure system security and reliability. The SCADA server shall be delivered with a lifetime warranty, covering hardware and software, and shall include free updates for all future security software releases. Regular Software / hardware updates/ upgrades for the life of project (25 yrs)

The Bidder shall ensure that patch management is provided for all server operating systems and SCADA/EMS software to maintain system security and reliability. The EMS/SCADA server shall be supplied with a minimum warranty period of two (2) years, covering both hardware and software. The warranty shall include free updates for all future security-related software releases during the warranty period. Regular software and hardware updates/upgrades necessary for the EMS system shall be provided by the Bidder for the entire life cycle of the plant i.e 25 Years.

7.31.0 DOCUMENTS REQUIRED FROM BIDDER/VENDOR

Bidder to note that the following documents are required to be submitted along with bid proposal:

a) Sub-vendor list – Bidder shall follow Owner's approved vendor list. Any deviation shall require to be discussed during bid phase. No deviation shall be accepted post order.

b) Proposed System Architecture drawings

c) Complete Bill of Material

d) Design Basis and aspects

e) Full detail regarding equipment and systems including drawings, data, information, technical literature

f) Any other drawing/documents listed in respective equipment section

g) Confirmation certificate for the latest version of software and hardware proposed

h) Grid Compliance Report

7.32.0 DESIGN PHASE

a) Project Schedule (L3/L4 Level)

b) Exhaustive Master Document List (MDL) for drawings and documents

c) Technical Datasheet of Individual components.

d) List of deliverables items and packing list

e) Bill of Quantity

f) Detailed erection and commissioning procedure

g) Test procedure which includes FAT/SAT/PGTR per National and International Standard

h) System Architecture Drawing

i) Type test certificates for all equipment

j) Manufacturing quality plan

k) Field quality plan

l) O&M manual

m) Hardware/Software Bill of Quantities with model no./part no., Volume, weight, and dimensional details including spares.

n) Hardware Specification

o) Functional design document

p) Block Diagram

q) Guaranteed technical parameters, Functional design specification and guaranteed availability and reliability.

r) Calculation of power supply dimensioning

s) Control Room and Switchyard/Switchgear Layout (as applicable)

t) Complete documentation of implemented protocols between various elements.

u) System Configuration Diagram with interfacing details.

v) G.A. (General Arrangement) and Internal Arrangement drawings of all Control Panels / Cabinets / Consoles with all dimensional details, wiring diagrams and terminal details. w) Control loop configurations with write-ups and logical diagram

w) I/O assignment system including nest loading, spare capacity, and other engineering details.

x) Special tools/instruments for maintenance

y) Certificate from statutory body

z) Installation, Operation & Maintenance manuals

aa) Operating, programming, reference, and other manuals for software

bb) Maximum bus utilization under worst loading condition calculation details shall be furnished.

cc) Datasheets of each item

dd) Hardware & software design manual (covering exhaustive details of complete system)

ee) List of software included.

ff) Confirmation certificate for the latest version of software and hardware offered.

gg) Final documentation, Master clock system, as per the as-built status of the system

hh) Sub-vendor list

ii) Mandatory Spares List

jj) Any other drawings/ documents listed in respective equipment sections.

kk) Grid Compliance Report (of the PPC, by PSSE and benchmark with PSCAD, as per Report of the Working Group in respect of Data Submission Procedure and Verification of Compliance to CEA Regulations on Technical Standards for Connectivity to the Grid by RE Generators)

ll) Communication Protocol and security conformance tests

7.33.0 COMMISSIONING PHASE

Bidder shall share pre-commissioning site readiness checklist before mobilizing manpower at site.

a) Commissioning test procedures.

b) Detailed erection and commissioning procedure.

c) Test procedures which include Site Acceptance Test (SAT)/PG Test as per relevant IS/IEC standards.

d) Type test certificates for all equipment.

e) Manufacturing quality plan.

f) Field quality plan.

7.34.0 SYSTEM HANDOVER/AS-BUILT

- Final documentation, as per the as-built status of the system, Hardware/Software Quantities with model number/part number, volume, weight, and dimensional details (including spares).
- Operation & Maintenance manual updated.
- As-built drawings.