# Scope of Works

## About Project Objective:

Nepal Electricity Authority (NEA) intends to implement the Advanced Metering Infrastructure (AMI) System all over the country. The AMI system implementation is intended to automate and integrate the data collection and analysis process by reducing the meter reading costs, access to time of use-based tariffs and cut back in AT&C losses to make business processes efficient, more robust and reliable to meet the present and future challenges.

Also, the Organization's aim is to provide best services to its consumers by implementation of automated Smart meter reading & billing processes at provinces, division and DCs offices across its entire country. The AMI System implementation will ensure automatic capturing of information & will result in better monitoring, maintenance, planning and decision making for its distribution network.

The objectives of AMI System implementation project have been broadly outlined and listed below:

- To automate meter reading, data entry and billing (avoid human interface in meter to cash process, faster billing cycle, reduce errors).
- To automate connection/disconnection of electricity supply (remote connect/ disconnect).
- To enable real time energy auditing.
- To identify phase imbalance.
- To have visibility of loading on the power system which enables better prevention of failure/avoid under-utilization of equipments.
- To enable load management monitoring in real time.
- To introduce/implement Time of Use (ToU) tariffs for different categories of customers.
- To enable Net-metering.
- To enable real time monitoring of distribution transformers/feeders.
- To analyse all events & alarms captured by the smart meter through Meter Data Management System (MDMS)

# Project Scope of Work

Nepal Electricity Authority (NEA) with a vision to provide, uninterrupted power supply to every consumer is under process of implementing Advance Metering Infrastructure (AMI) to bring reforms in power distribution sector at Nepal. Under this process, it is implementing approximately 2.7 Million no's of Smart meters in Koshi and Madhesh Province to cover all the customers in the province.

AMI System or AMI infrastructure includes "smart meters with enclosures, communication devices, communication infrastructure, HHUs/CMRIs, HES, MDM, Consumer Mobile App,

Meter installation app, Analytical software and other necessary supporting software as mentioned in detailed scope of work".

The Scope of work of the project shall include site survey, planning, designing, financing, engineering, manufacturing, supply, transportation & insurance, delivery at site, unloading, handling, storage, installation, integration, testing, commissioning, demonstration for acceptance, training, maintenance, operation and documentation of various components given below. SI shall carry out the installation of necessary infrastructure (Smart meters, DCU, components AMI infrastructure (at DC & DR) and its maintenance for all the consumers under its jurisdiction. The total period of contract would be 10 years including 3 years of implementation period and Operation and Maintenance support for 7 years which is further extendable year on year based on mutual agreement.

**AMI Service Provider** shall Design, Build, Finance, Own, Operate, Transfer (DBFOOT) the Advance Metering Infrastructure (AMI) Project in the post-paid (by default) mode in selected AMI Project Area. The AMI Service Provider shall finance and implement the project including end-to-end smart metering, operate for 'Total Meter-months' as defined in this Contract and thereafter transfer the ownership of the entire system including all the hardware, software along with its valid licenses, and any data collected during the Project to the Utility at the end of the Contract Period to facilitate seamless operation of Utility businesses. Utility shall make payments to the AMI Service Provider in accordance with the terms and conditions of this Contract.

The AMI Project shall be implemented in the Project Area within 23 DCs in Madhesh Province and 24 DC in Koshi Province where all 2.7 million single phase and Three phase consumers shall be smart metered to enable complete energy accounting with zero manual intervention and non-contiguous electrical locations where dispersed metering for certain Industrial, Commercial and Government consumers shall be done.

    i.    The intent of this project is to implement the AMI system for all Distribution consumers with following functions: Capability to access the real-time data and provide all information on a single console in an integrated manner with the possibility to remotely control the entire network and increase operational efficiency.

   ii.    Bidder shall establish network platform that can support the multiple applications like AMI, DMS (Distribution management System), DER (Demand energy response), Street Light Management and HAN etc.

  iii.    The Network canopy to be established using RF/PLC/GSM or combination of any two communication technology shall communicate with field devices using intermediate network elements such as routers/repeaters/collectors/gateways/data concentrator's units/access points etc. In case the RF/PLC communication technology is not feasible at the specific consumer/metering location the bidder shall provide the 4G/5G/e-SIM/IOT with fall back to 3G/2G based network connectivity.

  iv.    The supplied smart meter shall have a provision for both RF/PLC/GSM and 4G/5G/e-SIM/IOT with fall back to 3G/2G communication network communication technology, with two separate NIC slots. The contractor will ensure the meter data communication/connectivity with centralized Data Center by establishing the connectivity over suitable/available communication network. In case two slots are not possible, One

Single slot with provision for both RF/PLC and 4G/5G/e-SIM/IOT with fall back 3G/2G communication is also permissible.

v. The contractor shall install smart meter with suitable communication technology. SI shall choose any combination of communication technology solutions like RF/PLC or 4G/5G/e-SIM/IOT with fall back 3G/2G communication network etc. to ensure agreed service level are met. SI shall obtain necessary prerequisites during the site survey for selection of suitable/reliable/workable communication technology for a specific area.

vi. The contractor shall note that at a time only 1 - NIC (4G/5G/e-SIM/IOT with fall back 3G/2G communication network.) will be installed/plugged into the smart meter.

vii. The RF/PLC/4G/5G/e-SIM/IOT shall field Swapable for smooth operation.

SI shall carry out the installation of necessary infrastructure (Smart meters, DCU, components AMI infrastructure (at DC & DR) and its maintenance for all the consumers under its jurisdiction. The total period of contract would be 10 years including 3 -year of implementation period and Operation and Maintenance support for 7 years which is further extendable year on year based on mutual agreement.

| Province | Domestic consumer count | | Demand consumers count | | Total consumer count |
|---|---|---|---|---|---|
| Projected number of consumers in next 10 years | Single phase | Three phase | Three phase | Tod three phase | |
| Madhesh Province (MP) | | | | | |

Table 1: Indicative number of Smart Meters projected in next 10years in MP.

**Site Study & Survey**

a) SI shall study the site locations with communication feasibility study to understand requirements for AMI including distribution of consumers, user's requirements & any other information as required for implementation and successful roll out of AMI system at the site's locations & offices of NEA.

b) SI should update the consumer indexing data within geographical boundary covered as part of the scope of work. The detail of new/shifted consumers and other new assets shall be provided by utility.

c) The survey shall be carried out by capturing GPS coordinates using a mobile application which should be able to identify erroneously captured coordinates on real time.

d) SI deliverables shall include the list of consumers with the relevant codes of indexing generated to be delivered substation wise feeder wise and DT wise as soon as the consumer indexing list is complete.

e) Surveyor shall walk along with the line and identify the consumers to whom supply is released from each pole/ service pillar and identify the Distribution Transformer from where each Consumer is fed.

f) SI shall study sites for validating AMI System end user network connectivity requirements with communication feasibility study, along with detailed layout drawings for network requirements. (Keeping the future expansion in view).

### Requirement Gathering

- SI shall conduct a detailed requirement gathering exercise with all important stakeholders for Smart meters, communication network including various modules & components of AMI system.

- SI shall arrive at the optimum design, architecture, and sizing of IT infrastructure for Data Center & Disaster Recovery Center based on the requirement gathering exercise and shall design the solution accordingly.

- SI shall also assess the end user expertise level at each office location and suitably modify Training/Handholding/Change management programs for various modules of AMI systems in consultation with NEA.

### Design and Documentation

a) At the end of site visits, SI would submit a report on status assessment & requirement gathering to the Nodal/Designated officers of NEA.

b) SI to formulate a report on As-Is Status study including communication infrastructure requirements for site & office locations of NEA.

c) SI shall submit the reports on As-Is status and TO -BE process documents for AMI systems to the Nodal/Designated officers of NEA

d) SI shall prepare and submit a detailed solution architecture and deployment architecture of the system (HLD & LLD Reports for IT infrastructure). SI shall submit Solution Architecture for IT infrastructure deployment for Data Center and Disaster Recovery Center.

e) SI shall submit the Guaranteed technical parameters for each of the field assets and obtain approval before manufacturing, design and supply.

f) SI shall design the AMI systems considering the user distribution and ensure optimum performance of the various modules.

g) SI shall factor necessary security parameters and shall be built in to ensure data security of AMI systems.

h) The proposed solution architecture shall be submitted and approved by the NEA before commencement of the customization and development.

i) SI shall provide all necessary documents and reports pertaining to the interfacing with the existing BI/MIS Systems.

j) The submitted documents and reports shall include but not limited to FRS, technical specifications, data model, solution design, business requirement document, periodic reports, change control document, system test scripts, acceptance test scripts etc.

k) SI shall develop manuals such as User Manuals, Training Manuals, FAQ & Trouble Shooting Guide, etc. as agreed upon with NEA for different kinds of users such as System Administrator, Super user, Normal user etc.

l) SI shall ensure that the documentation is in line with the defined documentation standards.

m) Solution Architecture & Communication Infrastructure deployment along with IP scheme: SI shall be required to design and provide IP addressing scheme for the Communication Infrastructure. The IP addressing scheme proposed by SI shall be reviewed by NEA.

n) This shall include the implementation of the approved IP addressing scheme including necessary configuration of the IP addresses in all the AMI Systems & Sub systems.

o) SI need to address the above requirements according to site-assessment and the solution design.

## Provisioning of DC and DR for AMI System

a) The bidder shall carry out the study of existing NEA Data Center for formulation of final Bill of Material for both Data Center (DC) and Disaster Recovery Center (DR). The SI is expected to finalize the BOQ by optimizing the IT infrastructure present at the DC and the DR and is expected to carry out the site survey before submission of the bid.

b) SI shall be responsible for supply and installation of necessary hardware, software and supporting system for successfully running the AMI system operations for scope of work at Data Center and Disaster Recovery Center.

c) SI shall supply, install, commission, and maintain the additional hardware and software systems whatever is required for AMI Solution stack including supporting system and services at Data Center (DC) and Disaster Recovery (DR) center.

d) SI Shall provide business continuity services from Disaster Recovery site, in case the primary site becomes unavailable.

e) NEA Shall Provide space and location of Data Center and Disaster recovery Site post award of the contract.

## Supply and Installation of AMI System

a) SI shall carry out the Design, Supply, Establishment, Operation and maintenance of Advanced Metering Infrastructure (AMI) for 2.7 million smart metering nodes within Koshi and Madhesh Province of Nepal.

b) It includes the supply and installation of single and three phase smart meters inluding meter boxes and associated accessories for DC/DR etc. along with the requisite communication infrastructure.

c) Supply and installation of meter data acquisition systems that enable two-way communication between NEA and customers.

d) Supply and installation of necessary hardware and software for successfully running the operations of AMI system.

**Software Design and Customization**

a) SI shall carry out the Design, Supply, Installation, Development, and Customization of modules based on the approved solution design, technical specifications document and FRS document for AMI systems.
b) SI shall prepare and submit a detailed project plan for the software development /customization.

**Solution Testing**

a) The SI shall conduct all types of software testing to ensure that the software is defect free and acceptable to NEA. Software testing shall be in accordance with the general testing procedures of the Software Development Life Cycle (SDLC).
b) The AMI system modules & sub-modules would be re-tested to ensure closure of identified defects/issues.
c) SI should provide detailed test scripts for carrying out the acceptance test of various systems supplied.
d) NEA shall nominate a team to carry out acceptance testing of the various modules supplied by SI for AMI System.
e) SI should provide necessary tools for logging of defects and carrying out testing if required.
f) SI should setup testing environment at the Disaster Recovery Center hosting facilities for testing requirements.
g) SI should provide training to the Acceptance Testing team prior to the commencement of the acceptance testing of the system.
h) SI shall resolve all the defects/issues identified by the NEA acceptance testing team during AMI System acceptance procedure/phase.
i) Any Level of development and fixes will be tested by support team of SI in development environment and subsequently UAT will be carried out by end users in test environment before they are implemented in production environment.
j) Subsequently, the authorized representative nominated by NEA shall issue an acceptance certificate which should be produced by SI to go ahead with the enterprise wide rollout of AMI system.

**Solution Integration**

The SI shall study the existing data models implemented as part of the existing smart metering system, SCADA, DMS, OMS, GIS and revenue management system implemented in NEA to build the AMI solution. The proposed solution shall be based on an open architecture and supports various types of interoperability and integration methods and should seamlessly

integrate with the existing solutions. The method of integration should be adapter based and the SI is required to ensure that the level of customizations is minimized to ensure code sanctity. Integration shall be as per IEC 61970.

All interfaces should be self-checking so that any exceptions or data validation errors are reported by system. Integration logs should be maintained to confirm the success or otherwise of the integration interface. Any adapters, licenses, tools, scripts etc. required for integration with the existing and upcoming IT solutions of NEA will need to be arranged by the SI. The access to data will only be through business rules i.e. the applications will not access data directly without going through APIs managed by business rules/validation/workflow. The integration middleware/interface must validate the Data to be integrated. NEA can arrange for a session with existing SIs in case the SI need to understand any of the existing solutions and clarify their doubts. The System shall accurately maintain system time synchronization across all devices to ensure accuracy of data.

**Solution Security**

The SI shall provide services of quality assurance through IT/Cyber Security ensuring compliance to the recommendations for AMI System. Proposed solution should comply with necessary IT/Cyber Security guideline of Government of Nepal. In accordance to electronic transaction Act 2063 and electronic transaction rule 2064 and their consequent amendments.

**Training and Handholding Support**

a) **Audience for training**: The audience of the trainings shall vary for each type of training. The basic training will cover all technical & Non-Technical employees of the NEA. Trainee shall be Nominated by NEA. The end user training for various AMI System Modules and other software systems shall be for the respective users of modules. The total number of expected trainees and batch sizes for each type of training shall be assessed by the SI during the As-Is assessment phase.

b) **Locations of training:** The SI will provide training at 2 set of locations. One in Nepal and the other abroad.

a. In the training that is imparted abroad, the SI will train 10 people for 10 days and arrange all travel, lodging, transportation, and logistics for NEA team.

b. In Nepal, the SI will train NEA end users for 30 days. To and fro charges and accommodation for the Instructor (Trainer), Trainee and Training material for the Trainees shall be included in the prices quoted by the bidder.

c) **Curriculum for training:** The SI shall propose the course content which shall be reviewed by NEA before acceptance by Nodal/Designated Officer. The course content shall be detailed as per the trainee needs.

d) The content of the training should be designed in a manner that allows users to make optimal use of the AMI System in day to day operations and should be formulated in discussion with the NEA. There should be provision to record training sessions which can be reused.

e) The standard contents of training should be documented and made available to all the trainees. Two copies in hard and soft format should be made available to the in-charge of every location and on the utility internal portals.

f) For the list of training to be conducted, the batch size etc. shall be analyzed by the SI during the As-Is assessment phase.

**Roll out, Stabilization Period and Go-Live Declaration**

Post successful roll out of AMI at all project locations, SI shall provide stabilization support for a period for three (3) months. The SI shall facilitate in setting up a central help desk for any queries which would have an automated helpdesk and service management tool. SI would be required to depute requisite numbers of people who would be responsible for resolving end-user queries and problems on AMI System and supporting software at NEA. The system will be called Go-live after due approval from NEA and compliance to the Go-Live criteria defined in the RFP.

**Operation & Maintenance (O&M) Support**

a) The SI shall carry out Operations and Maintenance support services for entire Project duration after the date of Go-live of the project.

b) During the O&M period the SI will provide Annual Technical Support (ATS) for hardware, Software of the of AMI system and databases which shall include all types of support, patches, bug fixes, upgrades etc. for complete project duration.

c) All the field components of AMI system shall have a warranty as prescribed in relevant sections of the RFP.

d) The details of all activities covered under the support and maintenance services and the expected service levels is mentioned in Operations and Maintenance Services.

Bidder(s) are advised to conduct site visits to be able to understand the requirements of implementation of AMI system at NEA.

Bidder(s) should propose all required functions from AMI System to meet the requirements of NEA. Bidder should note that the technical specifications mentioned in the RFP are only the minimum and indicative technical and functional specifications and Bidder should design and propose the solution appropriately keeping the SLA requirements and scalability in view as well as plan to conduct detailed design workshops to gather design requirements and customize the AMI system to the satisfaction of NEA.

**Responsibilities of the NEA**

DMD, DCS Directorate of NEA or any other person designated by the DMD of NEA shall act as the nodal point for the implementation of the Contract and for issuing necessary instructions, approvals, commissioning, acceptance certificates, payments etc. to the **AMI Service Provider**.

The Utility shall:

a) Whenever implementation of any component of the Solution requires that the **AMI Service Provider** obtain permits, approvals, and import and other licenses from local public authorities, if so required by the **AMI Service Provider** make its best effort to assist the **AMI Service Provider** in complying with such requirements in a timely and expeditious manner.

b) approve all such documents required for completion of Pre-Operational Go-Live Phase, in accordance with Clause 11 of this Section, within 15 (fifteen) working days from the date of submission of such final documents.

c) Provide on **AMI Service Provider**'s request, particulars/ information / or documentation that may be required by the **AMI Service Provider** within 30 (thirty) days from date of execution of the Contract to enable preparation of the Project Implementation plan by the **AMI Service Provider.**

d) Provide existing database of consumer indexing and physical & IT infrastructure as available with the Utility. Utility shall provide all available required data to the **AMI Service Provider** to identify all the consumers connected on the identified sub-stations, feeder lines and transformers of the **contracts** Project area;

e) Review and approval of **AMI Service Provider**'s Project Implementation Plan;

f) Provide drawings for NOMC building where AMI system installations are planned;

g) Provide necessary inputs for developing a comprehensive consumer engagement plan;

h) Provide necessary approvals for shutdowns if required for implementing the AMI System;

i) *Provide the proper storage place within related DCs office for old replaced meters by the AMI Service Provider.*

j) Implement consumer engagement plan with support of **AMI Service Provider**. This would include running media campaign to raise awareness and countering myths around smart metering prior to installation, providing SOPs for smart meter installation to **AMI Service Provider**, etc.

k) Keep **AMI Service Provider** informed of any changes in the area network during the project installation and operation period. Furthermore, Utility will partner with **AMI Service Provider** for discovering/ updating consumer indexing (DT/ Feeder wise) after installation of smart meters through structured power events data analysis including scheduling such events for each node with minimum inconvenience to consumer.

l) Provide A.C. power supply inputs.

m) Provide all required documents for delivery of material at site.

n) Provide at its expense, the electrical energy required for performance of the Project activities, installation, testing, and operation of the AMI Systems

o) Providing support and access to facilities at the sites, including consumer premises

p) Arrange for necessary shutdowns and work permits

q) Implement major civil works such as expansions or construction of rooms, trenches etc. as required for the AMI equipment

r) Ensure that sites for installation for Smart Meters are ready along with service cable including electrical neutral connectivity to the transformer, wherever applicable, for AMI Service Provider**.**

s) Provide the required integration interface details of the existing billing enterprise and related information required for Operational Go-Live of the AMI system, within 6 (six) months from date of execution of the Contract

t) Provide necessary clearance/ approval/ permits that are to be issued by it for initial 20% of contiguous electrical locations for Smart Meter deployment along with related documentation within 6 (six) months from date of execution of this Contract. Provide necessary clearance/ approval/ permits to be issued by it for remaining contiguous electrical locations as well as non-contiguous electrical locations for Smart Meter deployment along with related documentation on quarterly basis. Utility shall endeavor to provide 20% of contiguous electrical locations cleared each quarter and complete area within 18 (eighteen) months from date of execution of the Contract. Utility shall issue a Notice (provided if the Utility has not been able to provide clearance/ approval/ permits for installation of the meters) no later than 7 days of expiry of time period specified above confirming the actual number of meters for which clearance/ approval/ permits is available

u) Review the specifications of the Goods proposed to be used to ensure compliance with the provisions of this Contract.

v) Provide reasonable support to the AMI Service Provider for the Operational Go-Live in terms of the provisions of this Contract

w) Provide necessary support to AMI Service Provider in the Project area, in relation to (amongst others) access to Utility's/consumers premises, installation of AMI system, repair and maintenance services, etc. Utility shall also:

i. Give access to AMI Service Provider supervisor or its operation & maintenance staff to work in the Project area during the Contract Period;

ii. Provide an office space for AMI Service Provider personnel as mentioned in Clause 10 of this Section document within the Utility premises.

iii. Give access to AMI Service Provider to use existing power and water supply, and other necessary equipment, as mutually agreed with the AMI Service Provider ;

iv. Not move, remove, modify, alter, or change the AMI system or any part thereof in the boundary of the AMI system installed by the AMI Service Provider without the prior written consent of AMI Service Provider. Utility shall take all reasonable steps to protect the AMI system from damage or injury and shall follow procedure for emergency action provided in advance by AMI Service Provider

x) Participate in periodic review meetings as per the project governance structure, and shall support with the required interventions requested;

y) Be responsible for operation and maintenance of power supply system, and promptly attend to any break down including repair or replacement of any equipment used/needed for maintaining continuity of electricity supply for AMI system operation;

z)  Permit AMI Service Provider to perform the project activities during working hours, and also after working hours as necessary, to meet the requirements of Project Implementation Plan;

aa) Provide necessary support in creation of pre-payment infrastructure;

bb) Attend to any irregularity with respect to AMI system operation, the cause of which has been brought to its attention by the AMI Service Provider ;

cc) Promptly notify the AMI Service Provider of any events or circumstances that could affect the Project outcomes, or the AMI Service Provider Services and obligations under this Contract;

dd) Allow AMI Service Provider (and/or its implementation partner, investor(s), authorized agency) unfettered access to network operation cum monitoring centre. Such covered and enclosed space as required by AMI Service Provider shall be provided to it by Utility free of cost during the Contract Period;

ee) Cooperate with AMI Service Provider in arranging financing for the Project, including by signing any relevant documents (such as substitution Contract) and providing such approvals, no-objections and waivers as may be required by investors/lenders;

ff) Appoint and notify to AMI Service Provider of the names and contact details of the Utility representative and its dedicated staff for the Project, which would include:

 i.  An engineer-in-charge for the Project who shall render full support to AMI Service Provider for Service delivery during the Term of this Contract and shall coordinate for payment to AMI Service Provider;

 ii.  A nodal officer, Utility Project Manager, to co-ordinate with AMI Service Provider in relation to the Project.

gg)  Maintain consumer expectations basis the consumer engagement plan;

hh)  Certify Installation Milestone in accordance with the provisions of this Contract.

ii)  Facilitate AMI Service Provider for the timely implementation of the AMI Project and for its successful operation and maintenance during the Contract Period

jj)  Release payments to AMI Service Provider as per agreed terms

kk)  At its own cost, replace or repair existing equipment (other than AMI systems), such as poles, cables including consumer service lines, and transformers etc. where necessary to make the AMI system operational and/ or safe from hazards and maintain in proper working condition all portions of all facilities that are not included in the AMI Service Provider scope of maintenance

ll)  Provide all other necessary support as may be required time to time.

**1.1** Contractor shall carry out installation work of meter box, cable etc. with proper safety guidelines issued by the Utility for work at height, work on-live etc while also meeting all quality standards. Dismantling of existing meter boxes and other scrapped service cables from site and Erection & Commissioning of service cable and meter boxes along with necessary items like CT'S, lugs etc. as per guidelines of the Utility.

**1.2** AMI Service Provider will be responsible to provide sufficient number of teams for installation activities as per work schedule targets to complete the work. Each Team should comprise of at least one technician along with a supervisor.

# Technical Specifications

## General Overview

Nepal Electricity Authority (NEA) intends to implement an integrated, automated, secure and reliable Smart Metering System with data management, data processing & analysis and integration with existing MDMS System & NEA Billing System by replacing existing Single Phase/Three Phase Whole Current Electro-Mechanical Energy Meters and Non-Smart CT Operated Meters with Smart Energy Meters. The total scope includes supply, delivery, installation, testing, commissioning & training of Smart Energy Meters as well as maintenance during the entire Project duration and warranty period. The overall system shall be scalable to support easy addition of any number of similar Smart meters in future.

Technical Specifications of Smart Energy Meter covers the design, manufacture, assembling, inspection, testing at manufacturer work before dispatch, supply, delivery, installation and commissioning at Purchaser's site and design, development, installation and training for all required Fully Web-based Head End System (HES), Base Computer Software (BCS), various Mobile Application Software for Meter Programming, Installation, Replacement Works and Manual Meter Reading Works as per requirement. The turnkey works is including Replacement of existing Electro-Mechanical Meters and installation of Smart Energy Meters at various Branch Office / Distribution Center of NEA.

In order to ensure that the measurement of meter is accurate, there shall have a separate MCU in CM (Communication Module) that is responsible for the communication part only, and the upgrading of communication software of module will not affect the meter's accurate measurement. The communication software and meter software are separated to ensure that the measurement of meter won't change after carrying out the error inspection and meter tests, moreover the communication software of meter can be upgraded on request, which will not affect the meter's accurate measurement.

It is not the intent to specify completely herein all the details of the design and construction of meter. However, the meter shall conform in all respects to high standards of engineering, design and workmanship and shall be capable of performing for continuous commercial operation in a manner acceptable to the purchaser, who will interpret the meanings of drawings and

specification and shall have the power to reject the meter which is not in accordance therewith. The offered meter shall be complete with all accessories, hardware, software and components necessary for their effective and trouble-free operation. Such components shall be deemed to be within the scope of bidder's supply irrespective of whether those are specifically brought out in this specification and/or the commercial order or not. The bidder should follow the international metering standards IEC-62052/IEC-62053 and ensure for availability of following technical specifications.

The accuracy class for single phase whole current meters shall be Class 1.0 for Active Energy (kWh) and Class 2.0 for Reactive Energy (kVARh) with accuracy for current range of 5-60Amps.
The accuracy class for Three phase whole current meters shall be Class 1.0 for Active Energy (kWh) and Class 2.0 for Reactive Energy (kVARh) with accuracy for current range of 5-100Amps
.
The accuracy class for Three phase CT Operated shall be Class 0.2 for Active Energy (kWh) and Class 2.0 for Reactive Energy (kVARh) with accuracy for current range of 5-6Amps.

The meter shall operate with specified accuracy for power factors in the full range of all quadrants.
The meter shall be of the surface mounting type and shall have terminals at the bottom.
The insulation class of the meter shall be Protection Class II and rated impulse voltage shall be 6 kV minimum.
The meter shall have minimum 20 years of life span and it shall operate within the stipulated error limits for full life span without any recalibration.
Maximum Internal power consumption should be 10VA (2W) for voltage circuit each phase and 4VA for phase current circuit for meter without communication modem.
The meter should have the capability of neutral current measurement.
Bi-directional Energy measurement with separate energy display in LCD and registration power injection and drawl from and to NEA Grid.

Measuring quantity for energy should have resolutions of Min 0.01 kWh for Active Energy and Min 0.01 kVARh for Reactive Energy. Clock setting /RTC set as per Nepali Bikram Sambat (B.S.) Calendar.
When the equipment offered by the bidder conforms to standards other than those specified above, salient points of difference between standards adopted and the standards specified in this specification shall be clearly brought out in the relevant schedule.
The smart energy meter must be useful for Net Energy Measurement. It should be suitable to use for both On-Grid and Off-Grid interconnection points. It shall be able to work as Single Metering unit for Bi-directional Energy Measurement with separate energy display in LCD and registration for Power injection and drawl from and to NEA Grid. The meter shall record and display Active and Apparent Power & Energy in both Import and Export Mode.
The meter must have modular communication slot to support all types of communication module like /RF/PLC/GPRS/3G/4G with IPv4, IPv6 and IPv4v6 communication protocols.

## Functional Requirement of Smart Energy Meter:

**A. The overall system shall be the core application as interface to the Smart Energy Meter & shall be able to perform following functions:**

• Nepali Bikram Sambat (B.S.) Calendar based Smart Energy Metering System.
• Acquisition various data/parameters on-demand & at user selectable periodicity from Smart Energy meter.
• Two-way communication with Smart Energy Meters to read and write over TCP/IP Protocol.
• SMS based two-way M2M (Meter to Mobile to Meter) Communication for reading and writing.
• Signal for connection & disconnection of load control switches.
• Audit trail and Event & Alarm Logging.
• Encryption of data for secure communication.
• Store raw data for defined time duration.
• Handling of control signals/event messages on priority.
• Shall support creating and maintaining the system operator, roles, access control permissions and home page permissions.
• Shall have the ability to create roles and user groups.
• Shall allow assignment of roles to users and groups.
• Accessibility to system functionality shall be authorized through roles.
• Shall be automatically updated based on the associated group or role.
• Both, Automatic and Manual disconnection & re-connection of relay based on configurable logic
• Postpaid or Pre-paid Metering with Web/Mobile applications.
• Data integration with other system like HES/MDM & NEA Billing.
• Common Dashboard to monitor/display all Smart Energy Meters in respective branch/Hierarchy with communication or non-communication status and display in GIS map of Nepal when needed.
• Net-Energy Measurement.
• Integration with existing core Billing Software of NEA for monthly consumption bill preparation automatically and send/dispatch to consumers' email address and also send related information as SMS to consumers' mobile number on billing date.

**B. The System shall facilitate programming of following meter parameters:**
• Load profile capture period (default 30 mins)
• Demand integration period (default 30 mins)
• Setting of parameters for time of day (TOD/TOU) billing
• Billing date as per Nepali Bikram Sambat (B.S.) calendar
• Calendar as per Nepali Bikram Sambat (B.S.) calendar
• Connect /disconnect of relay (maximum load not more than rated current)
• Load curtailment limit – Current limit, Power/Maximum Demand limit
• Event setting for connect/disconnect
• Number of auto-reconnection attempt
• Time interval between auto-reconnection attempt
• Lock-out period for relay
• Remote firmware upgrade for meter and modem
• Remote configuration (CFG) file writing

- Password setting
- Push schedule
- Setting threshold limits for monitored parameters
- Provision for adding more programming features in the future
- Data module for load profile 1, load profile 2, load profile 7, load profile 9 and billing profile as provided by NEA.

| ID | Requirement | Description | Criticality | Response* FC/NC/CC | Comments / Remarks |
|---|---|---|---|---|---|
| **SM-1.0** | **Three Phase 4 Wire AC Whole Current Smart Energy Meter Features** | | | | |
| SM-1.1 | Meter Data Record | Meter shall record billing, load survey, event & tampers, instantaneous and demand parameters. | Essential | | |
| SM-1.2 | Inbuilt Memory | Inbuilt permanent non-volatile memory to store all relevant meter data, events for a minimum of 365 days. (30 min interval) | Vital | | |
| SM-1.3 | Load Limit | Support remote load management by sending load curtailment signals via SMS/Web application. | Vital | | |
| SM-1.4 | Data Communication | Compatible store and be capable to communicate requested data as per programmed interval. | Essential | | |
| SM-1.5 | Tamper Detection | Detection, Notification, Resolve abnormal & tamper events and store the same with alert to NEA personnel via Email/SMS | Essential | | |
| SM-1.6 | Configuration Flexibility | Flexible configurations to support customized needs like load profile, time of use, demand metering and load control schedules. | Essential | | |
| SM-1.7 | Basic Features | a) Full quadrant energy measurement (import/export, lead/lag) <br> b) Net or gross measurement options <br> c) Fundamental Energy measurement <br> f) Configurable event logging and tamper detection <br> e) Programmability and reset capability. <br><br> The meter shall have manual/automatic, remote/local programming reset function to record the monthly energy | Essential | | |
| SM-1.8 | Communication Indication | Meters shall have indication of communications with the HES network so that a technician servicing a meter can determine communications success with the HES network. | Essential | | |
| SM-1.9 | Self-discovery and self-registry functionality | Meters shall have self-discovery and self-registry functionality to allow the HES system to detect and register the meter within 60 minutes of meter connection and establishment of communication. | Essential | | |
| SM-1.10 | Test Output | The meter shall have a test output accessible from the front and be capable of being monitored with suitable testing equipment. The operation indicator must be visible from the front. Test output device shall be provided in the form of LED output device for kWh and | Essential | | |

| ID | Requirement | Description | Criticality | Response* FC/NC/CC | Comments / Remarks |
|---|---|---|---|---|---|
| | | KVARh measurement. The relation between test outputs shall comply with the marking on the name plate or with the indication on display if so provided in addition to details on name plate I.e. pulse per KWh / KVARh. | | | |
| SM-1.11 | Salient Features | The meters shall have the following additional salient features:- <br>• The meter shall have provision to power up LCD for manual reading via push button through battery in the absence of AC power. <br>• The meter shall work accurately irrespective of phase sequence of the mains supply. <br>• The meter shall remain powered-up and functional in presence of any two wires. <br>• The meter shall continue to record accurately as per prevailing electrical conditions even if the neutral of supply gets disconnected. <br>• The measurement by meter shall not get influenced by injection of chopped signal / DC signal and harmonics in any of outgoing leads of the meter. <br>• Drawing of current through local earth. The meter shall register accurate energy even if load is drawn down partially or fully through local earth. <br>• The meter shall be programmed for both kWh, KVA MD However other programmable parameters shall be made available as per requirement. | Essential | | |
| SM-1.12 | Self-Diagnostic Feature: | The meter shall be capable of performing complete self-diagnostic check to monitor the circuits for any malfunctioning to ensure integrity of date memory location all the time. The meter shall provide information for unsatisfactory/non-functioning/ malfunctioning of the following: <br>• Time and date <br>• All display segments as per the requirement <br>• Real Time Clock (RTC) <br>• Non Volatile Memory (NVM) <br><br>If possible, the details of malfunctioning shall be recorded in the meter memory and alarm for this to be sent to HES system. | Essential | | |
| **SM-2.0** | **Load Control : Disconnection and Reconnection** | | | | |
| SM-2.1 | Disconnect /Reconnect switch | All meters shall have a provision of Disconnect /Reconnect switch/contactor for demand limit and current limit. | Vital | | |

| ID | Requirement | Description | Criticality | Response* FC/NC/CC | Comments / Remarks |
|---|---|---|---|---|---|
| SM-2.2 | Remote Disconnect /Reconnect | The HES system shall support remote disconnect/ reconnect of customer supply. | Vital | | |
| SM-2.3 | Disconnect Supply | When the HES performs a disconnect operation, then outgoing power circuits from the meter for all phase shall be disconnected. | Essential | | |
| SM-2.4 | Connection status of meter | To confirm the current state of a meter, the HES system shall support "On-Demand" remote polling of the meter to determine whether the supply is open or closed/whether meter is energized or not. The meter shall provide clear local visual indication of the status (open/closed) of the supply contactor. | Essential | | |
| SM-2.5 | Phase Disconnection | Disconnection of phase shall be performed in case of following:<br><br>a.) Over current ( more than rated current) in any or all phases<br><br>b) demand exceed approved demand<br><br>c) Pre-programmed tamper conditions<br>d) Disconnect signal from utility control<br><br>Centre such as balance unavailable in case prepaid facility is availed by consumer. | Essential | | |
| SM-2.6 | Remotely programmable. | Load control limits shall be remotely programmable. | Essential | | |
| SM-2.7 | Change mode of Payment | Easily integrate in system when pre-post mode of payment is active mode and vice versa with MDM | Essential | | |
| SM-2.8 | Audiable Alarm | Meter shall have the provision of audiable alarm for low balance (Prepaid) | Essential | | |
| SM-2.9 | Automatic Connection / Disconnection | The meter shall be capable of automatically disconnect the supply when a decision to disconnection is made and reconnect automatically when a decision in that effect is made. | Essential | | |
| SM-2.10 | Event Log | Special Event Log records entries for at least 10 previous disconnections, i.e. reconnections of the switching module, with the time stamp and switching module status shall be provided. | Essential | | |
| SM-2.11 | Self-discovery and self-registry functionality | Meters shall have self-discovery and self-registry functionality to allow the HES system to detect and register the meter within 60 minutes of meter connection and establishment of communication. | Essential | | |

| ID | Requirement | Description | Criticality | Response* FC/NC/CC | Comments / Remarks |
|---|---|---|---|---|---|
| SM-2.12 | Connect/Disconnect Indication | Meters shall have provision to display the indication for Connect/Disconnect: a.) Status of Relay – i.e. Connected / Disconnected shall be available on display as well as through communication. b.) Connection and Disconnection shall also be logged as events. Such twenty events shall be recorded. | Essential | | |
| SM-2.13 | Programmability Security | It shall be possible to program the parameters limits/values from remote through sufficiently adequate security mechanism. Once programmed it will be possible for the programmed parameters to come into effect from a certain date & time. Meteorology under such condition must remain intact and shall not be upgradable from remote | Essential | | |
| SM-2.14 | Reading Frequency | Meter shall support for reading of meter data on pre-defined frequency and it shall be configurable. On-demand meter reading facility shall also be available. | Essential | | |
| SM-2.15 | RTC and time Synchronization | Meter shall have RTC with 20 years Nepali Bikram Sambat (B.S.) based calendar programmed in the memory and provision for time synchronization. | Essential | | |
| **SM-3.0** | **Tariff and TOU Programming** | | | | |
| SM-3.1 | Remotely Configurable | The tariff and TOU implementation shall be remotely and locally configurable and robust to communication failures. | Essential | | |
| SM-3.2 | Tariff Store | Total energy register of kWh data shall be separately stored for each tariff. | Essential | | |
| SM-3.3 | Tariff Seasons | At least 4 seasons shall be definable and configurable. Only one season and one tariff shall be in operation during any time. | Essential | | |
| SM-3.4 | Season define | A season shall be defined by a month, day and shall be in effect starting at 00:00 hours of the defined day in every year, and shall be superseded when the next season becomes effective. Holidays, weekdays and special marked days shall be definable during a season. | Essential | | |
| SM-3.5 | Display Tariff | Meter shall have continuous display of current active tariff register regardless of its display mode. | Essential | | |
| SM-3.6 | Tariff Register Management | Local tariff register management shall be realized via internal clock. Tariff programmed shall anticipate the possibility of defining | Essential | | |

| ID | Requirement | Description | Criticality | Response* FC/NC/CC | Comments / Remarks |
|---|---|---|---|---|---|
| | | seven different days and one or two different days for holidays. Tariffs may be changed during one day for at least 3 times. | | | |
| **SM-4.0** | **Meter Data Storage** | | | | |
| SM-4.1 | Meter Internal Memory | All meters shall utilize non-volatile memory for storing and retaining meter data | Essential | | |
| SM-4.2 | Data Storage | Data storage shall be sufficient to provide redundancy for at least 365 days of at least two channels of data at 30 minutes interval.<br><br>Monthly energy consumption (under different TOUs, import/export with critical and non-critical loads) and the maximum demand for one year load, profile data for at least six month. | Essential | | |
| SM-4.3 | Data Security | Meter data shall be retained without loss or degradation without power | Essential | | |
| SM-4.4 | Data Retrieve | Meter data shall be manually retrievable without having to remove a meter cover | Essential | | |
| SM-4.5 | Data Download | Meter shall be capable of retaining data store in its memory at all the time even under a loss of power. It shall be possible to query historical readings manually and locally and shall be able to download the same for analysis purpose. Meter data shall be manually retrievable without having to remove a meter cover. | Essential | | |
| SM-4.6 | Meter Integrity | Meters shall have metering integrity violation (terminal cover opening, parameter change, strong magnetic field impact on the meter etc.) recording and signaling function. For each of the indicated events, Event Log shall make a record with a time stamp when this event occurred, for each of the indicated events. | Essential | | |
| **SM-5.0** | **Event log** | | | | |
| SM-5.1 | Meter Event | Meter memorizes events related to metering, adjustment and handling into the special memory registers (organized under FIFO principle). | Essential | | |
| SM-5.2 | Record of event | A record in the memory is generated for each event memorizing the type of event, time stamp and meter status when the event occurred. Meter registers at least 200 events. Threshold for recording an event should not be less than 300 seconds. | Essential | | |

| ID | Requirement | Description | Criticality | Response* FC/NC/CC | Comments / Remarks |
|---|---|---|---|---|---|
| SM-5.3 | Event security | Event coding as well as the type of events entered in the Event Log shall be organized under the recommendations given in DLMS/COSEM. Event Log is not erasable via any external intervention. | Essential | | |
| SM-5.4 | Special Event | Events recorded in special event logs, (events related to electricity quality, metering integrity, consumption management, etc.) are not recorded in the standard Event Log. | Essential | | |
| SM-5.5 | Supply Interruption Registration | Meter to be registered the number and total duration of short-term supply interruptions (supply interruptions shorter than 3 minutes) and long-term supply interruptions (supply interruptions longer than 3 minutes), recorded in the electricity quality log. Supply interruption (short term and long term) shall be configurable. | Essential | | |
| **SM-6.0** | **Self-Check** | | | | |
| SM-6.1 | Verify Meter Function | The purpose of this function is to verify proper execution of basic meter functions. Meter performs self-check during network connection, i.e. after every supply restoration (power-up). | Essential | | |
| SM-6.2 | Firmware Update | Meter will during application of new firmware perform self-check. Results of this self-check will be available on the meter (locally and remotely). New firmware upgrade in the meter may be done locally or remotely. | Essential | | |
| **SM-7.0** | **Meter Firmware Upgrade** | | | | |
| SM-7.1 | Firmware Upgrade | Meter shall support firmware upgrade for Meter and Modem whichever is needed. **Firmware upgrade option in the meter is realized not to alter in any way the metering characteristics (metrology) of the meter, data memorized in the meter (metering data, statuses, etc.).** Configuration parameters or operational parameters of the meter all these data remain unchanged even after firmware upgrade. | Essential | | |
| SM-7.2 | Firmware Compatibility | Meter will after be receiving the new firmware verify its compatibility in case that verification does not end positively, new firmware will not be executed. Meter will record time and data of new firmware receipt in the Event Log, as well as time and date of new firmware application. | Essential | | |

| ID | Requirement | Description | Criticality | Response* FC/NC/CC | Comments / Remarks |
|---|---|---|---|---|---|
| SM-7.3 | Local Firmware Upgrade | In the process of firmware up gradation of the meter locally, the recorded data should not altered in any case. **If for some reason firmware up gradation do not complete successfully, the firmware should revert back to the previous one automatically without any loss of the recorded data.** Event Log shall record all actions. | Essential | | |
| SM-7.4 | Remote Firmware Upgrade | In the process of firmware up gradation of the meter remotely via communication module of meter and Head End System (HES), the recorded data should not altered in any case. **If for some reason firmware up gradation do not complete successfully, the firmware should revert back to the previous one automatically without any loss of the recorded data**. Event Log shall record all actions. | Essential | | |
| **SM-8.0** | **Quantities To Be Measured, Monitored And Memorised** | | | | |
| SM-8.1 | Measureable Quantity | The meter shall be capable of measuring, monitoring and storing in the memory minimum eight (8) register with at least four (4) zones of time of day electrical quantities for pre-specified;<br>• Active energy: kWh, Bi-directional<br>• Reactive energy: kvar, Bi-directional<br>• Maximum Demand: kVA | Essential | | |
| SM-8.2 | Mode for display: | The meter shall have 3 modes for display:<br><br>**i.) Mode-1 (Auto Mode Display):** Meter default display mode shall be auto-scrolling display, after meter runs for a certain time (for auto-scrolling display circle, default as 10 seconds and form 1s to 60s shall be configurable), it shall switch to the next screen display automatically. Auto-scrolling display table shall be configurable and shall support to configure 60 parameters items, | Essential | | |

| ID | Requirement | Description | Criticality | Response* FC/NC/CC | Comments / Remarks |
|---|---|---|---|---|---|
| | | detailed display information please see display list.<br><br>**ii.) Mode-2 (Manual Mode Display):** On pressing manual key button, meter shall enter into manual display mode. In this mode, the display parameter screen shall switch to the next parameter screen display while pressing button. When button-press operation is stopped, meter shall return to auto-scrolling display mode automatically in a certain time as configured when meter is power-on or enter in to power-off display mode when meter is power-off.<br><br>**iii.) Mode-3 (Power-Off Display Mode):** When meter is in power-off condition, the LCD display shall remain-off as default status. However, if manual button is pressed, the LCD display shall remain power-on and need to display respective parameter. On pressing Manual button, meter shall switch to next parameter screen displays. If manual button is not pressed within configured time (after 20~80s), the LCD display shall remain power-off.<br><br>**4.) High Resolution Mode:** This mode shall display high precision readings of energy for accuracy testing at meter site. The display items shall be same as in auto-display mode. | | | |

| SM-9.0 | **Last Gasp Outage Alert** | | | | |
|--------|----------------------------|---|---|---|---|
| SM– 9.1 | Power Outage Notification | Smart meter shall have functionality in the case of power outage, the end point shall send a power outage message to HES/MDM Server which shall be populated on outage map of HES/MDM Server. This functionality shall help utility to identify the power outages on real time basis. | Essential | | |
| **SM-10.0** | **Security and Tampering** | | | | |
| SM-10.1 | Firmware Verification | Meter shall verify its' firmware at power-on and prior to activation of the firmware. It shall provide tampering protection for main and terminal cover removal and shall provide magnetic field detection monitoring. | Essential | | |
| SM-10.2 | Access Verification | For the purpose of data security, locally accessed data have to be protected by access right verification with at least three access levels and transferred data encryption. | Essential | | |
| SM-10.3 | First Protection Level | The first protection level is protection against unauthorized data reading via Optical Port/ Serial Port and it is realized through software package installed on the laptop, presenting itself to the meter, enabling data transfer and reading. | Essential | | |
| SM-10.4 | Second Protection Level | The second level of protection is protection against unauthorized changes in meter parameter set, with removing the terminal cover (violation of distribution company seal) for local communication. It is also realized through a software package installed on laptop, depending on the user type, as well as password verification; it enables transfer of certain parameter changes to the meter. Parameters which can be changed at this level are time and tariff programmed. However, this is not needed for remote communication from HES System. | Essential | | |
| SM-10.5 | Third Protection Level | The third protection level is protection against unauthorized meter firmware change, other meter parameters, as well as local disconnection/connection of the switching module. These actions on the meter are enabled after removal of terminal cover (violation of distribution company seal) for local communication, but only after verification of user type of software package installed on the handheld device/laptop, as well as meter password. However, this is not needed for remote communication from HES System. | Essential | | |
| SM-10.6 | Tamper Events | Minimum of total two hundred (200) events (occurrence and restoration) of all types of tamper with date and time shall be available in | Essential | | |

| | | the meter memory on first in, first out basis. Compartments, if any may be clearly indicated in the bid. Snap Shots shall be available (numerical values) of voltage, current, power factor and energy (kWh) readings as well as the date and time of logging of the occurrence and restoration of tamper events. | | | |
|---|---|---|---|---|---|
| SM-10.7 | Tamper Sequence | The tamper events shall be recorded in sequence manner in FIFO/Roll Over basis. The total numbers of Tamper counts to be displayed and memorized shall increase as per occurrence (not restoration) of tamper events. The total number of tamper counts shall also be provided on the meter display as well as at the BCS end. Cover Open Event, Magnetic Interference shall be communicated back to Base Computer Centre as and when they occur. These tamper events shall be sent as an alarm to the base computer centre which shall store the same in its database. | Essential | | |
| SM-10.8 | Tamper Time | The tamper persistence time for logging/registration of an occurrence and restoration of tamper shall be as per IEC standards. | Essential | | |
| **SM-11.0** | **Sealing Of The Meter** | | | | |
| SM-11.1 | Seal Arrangement | Reliable sealing arrangement shall be provided to make the meter tamper proof and to avoid fiddling or tampering by unauthorized persons. For this, at least two (2) Nos. seals on meter body, two (2) No. seal on meter terminal cover, one (1) No. seal on MD reset button (Such button must be provided) shall be provided in front side. | Essential | | |
| SM-11.2 | Polycarbonate Plastic Seals | The bidder shall have to provide two Polycarbonate Plastic seals on the meter body of each meter before dispatch of the meter. The plastic seal shall have embossing of the bidder's logo on one side of seal & NEA & Serial. No. of Seal on other side of seal. 6 Digits Serial. No of seal is to be provided on both male & female part of the seal. | Essential | | |
| SM-11.3 | Tamper Proof Void Seals | In addition to 2 Nos. of polycarbonate seals, further 2 Nos. of tamper proof void seals are to be provided on the Meter body in such a way that both the side covers shall be sealed by the tamper proof void seals. | Essential | | |
| SM-11.4 | Specifications of void seal | I) The seal shall be digitally printed on white VOID film having UV destructive inks printed with thermal resin ribbon technology. II) The seal shall be water proof and shall withstand all the weather conditions. The seal shall have adhesive of sufficient strength to | Essential | | |

| | | avoid peeling off under extreme temperature and environmental conditions. III) The seal shall be sticker type seal and applied on both the side of the Meter which connects the body and the box. IV) If someone lifts the seal, "VOID" impression shall be transferred on the meter and if this is applied back, "VOID" impression shall be readable from the surface of the seal. V) Barcodes of serial numbers shall be printed at the front side of meter and the barcodes shall be readable with a barcode scanner. VI) The seals shall have continuous variable serial numbers along with security codes of last three digits of serial numbers printed in black and the same serial numbers along with code of serial numbers shall also be printed in a vertical semi-circular shape which shall be visible only under Ultra-violet (UV) light. VII) Two security cuts shall be given on the seal on both the sides, and if someone tries to lift the seal it shall tear off from the security cuts. The security cuts shall be made with a computer controlled plotter which shall put the security cuts on the same position on each seal. VIII) If someone tries to remove the seal by applying heat, the printing shall get disturbed and the shape of the seal shall change if more heat is applied. | | | |
|---|---|---|---|---|---|
| **SM-12.0** | **Display Of Meter Values** | | | | |
| SM-12.1 | Display Character | The measured value(s) shall be displayed on eight digit LED/LCD display with backlit unit, having minimum character height of 8 mm. Good quality display shall be used to enable correct reading even from distance. | Essential | | |
| SM-12.2 | Data Retain | The data shall be stored in non-volatile memory. The non-volatile memory shall retain data for a period of not less than 10 years under un-powered condition. | Essential | | |
| SM-12.3 | Parameter Symbol | It shall be possible to easily identify the displayed parameters through symbols / legend on the meter display itself. | Essential | | |
| SM-12.4 | Display Multiple values | In case of multiple values presented by a single display, it shall be possible to identify each displayed value/parameter through separate symbol/legend to be made available on the display itself. | Essential | | |
| SM-12.5 | Persistence Time | Persistence time for each parameter shall be 10 second. | Essential | | |

| SM-12.6 | Meter Serial Number | In addition to providing serial number of the meter preferably on the display or on the meter name plate, the meter serial number shall also be programmed into meter memory for identification through CMRI/meter reading print out. | Essential | | |
|---------|---------------------|------|-----------|--|--|
| **SM-13.0** | **Maximum Demand** | | | | |
| SM-13.1 | Maximum Demand (MD) Registration | The meter shall monitor and calculate the average demand in KVA established during pre-specified integration period set and record/display the maximum registered value and the same shall be stored along with date and time when it occurred in the meter memo The integration period shall be 30 minutes and it shall be programmable with due authentication. MD must be available also for TOU registers. | Essential | | |
| SM-13.2 | Maximum Demand Reset | Automatic resetting at the end of pre-specified date of every calendar month (e.g. 00.00 hours of specified date). | Essential | | |
| SM-13.3 | MD reset authentication | A provision for revising the resetting cycle for modifying the date and time of automatic resetting through base computer service (BCS) centre or via hand-held meter reading instrument only after using protected password through authenticated BCS shall be available. | Essential | | |
| SM-13.4 | MD count | In all the MD resets, Nos. of counts shall increase on every reset. | Essential | | |
| **SM-14.0** | **Load Survey Capability:** | | | | |
| SM-14.1 | Load Survey Storage | Meter shall record load survey of minimum 365 days for Voltage, Current, Power Factor, bi-directional energy for TOU and phases, MD at interval of 30 minutes in FIFO manner. | Essential | | |
| SM-14.2 | Load Survey Display | The load survey data shall be presented graphically as well as in spread sheets. The presentation should be for single entity as well as for multiple entity. | Essential | | |

**Applicable Standards**

Unless otherwise specified elsewhere in this specification, the performance and testing of the meters shall conform to the following National/International Standards and all related National /International standards to be read with up To-date and latest amendments/revisions thereof.

Smart energy meter shall be in accordance with the standards specified below or later editions and/or amendments thereof. The electricity meters shall conform to all appropriate IEC standards including, but not limited to, the following:

**IEC 62052-11** – Electricity metering equipment (a.c.) – General Requirements, tests and test conditions Meter – Part 11 Metering Equipment.

**IEC 62053-21** - Electricity metering equipment (a.c.) - Particular requirements - Part 21: Static meters for active energy (classes 1 and 2).

**IEC 62052-31** - Electricity metering equipment (a.c.) – General requirements, tests and test conditions – Part 31: Product safety requirements and tests.

**IEC 62056-21** - Electricity metering – Data exchange for meter reading, tariff and load control – Part 21: Direct local data Exchange.

**IEC 62053-21**-Power consumption, voltage requirements, accuracy and local interface.

**IEC 62053-61** - Electricity metering equipment (a.c.) - Particular requirements - Part 61: Power consumption and voltage requirements.

**IEC 62056 Electricity metering** – Data exchange for meter reading, tariff and load control – Parts 42, 46, 47, 53, 61, 62.

**IEC 62058-11** - Electricity metering equipment (a.c.) - Acceptance inspection - Part 11: General acceptance inspection methods.

**IEC 62058-31** - Electricity metering equipment (a.c.) - Acceptance inspection - Part 31: Particular requirements for static meters for active energy (classes 0, 2S, 0, 5S, 1 and 2).

**IEC 62053-22 –**- Electricity metering equipment (a.c.) - Acceptance inspection - Part 22: Static Meters for AC Active Energy clases (0, 1S, 0, 2S, 0, 5S).

**IEC 62053-24-** Electricity metering equipment (a.c.) - Acceptance inspection - Part 22: Static Meters for fundamental component reactive Energy classes (0, 1S, 5S, 1, 2 and 3).

**IEC 62053-22:2020 -** Electricity metering equipment -Particular requirements - Part 22: Static meters for AC Active Energy (classes 0.1S, 0.2S and 0.5S)

**IEC 60529 -** Degree of protection provided by enclosures (IP Code)

**ISO 2859 -** Sampling Procedures

**Meter Type & Certifications**

The manufacturer of meter must possess valid ISO 9001:2000 & ISO/IEC 27001:2013 certification with design in scope of certification.

The meter must be IDIS (Interoperable Device Interface Specification) Certified.

In case the bidder fails to submit above certification, the bid shall be rejected.

For the purpose, type of meter is considered as follows:

| Meter type | Compatible Communication Module | Connection & Disconnection Breaker |
|---|---|---|
| Single/Three Phase Direct Connection/ CT Operated | RF/GPRS/PLC | Yes |

**Electrical Requirements (Single Phase)**
- ➢ Rated voltage for single phase meter 230V (P-N)
- ➢ Voltage Variation range: -70% to +20%
- ➢ Rated Current: 5(60) Amp {5Amps ($I_b$=5Amp), IMax = 12Ib}
- ➢ Starting Current = 0.004Ib.
- ➢ Continuous current rating (Amp.) for single phase meters is 60Amp.
- ➢ Rated frequency: 50 Hz with +/- 5%.
- ➢ Both current and voltages shall be directly connected to the terminals
- ➢ Power Factor: Zero (lagging) through to Unity to Zero (leading)
- ➢ Must support minimum 4 TOU channels

**Electrical Requirements (Three Phase)**

- • The accuracy class -       1.0 for Active Energy (kWh), 2.0 for Reactive Energy (kVARh)
- • Rated Current -       5 (100) Amp {$I_b$=5Amp, $I_{max}$ = 20 $I_b$}
- • Rated voltage -       230V ($V_{ref}$, phase to neutral), a.c.
- • Voltage Variation range: - 70% to +20%
- • Starting Current -       0.004$I_b$.
- • Rated frequency -       50 Hz
- • Method of connection -   Direct
- • Operating Power Factor -  Zero (lag) to Unity to Zero (lead)
- • In-built load control switches. (Default current limitation ≤ $I_{max}$)
- • Single shot three pole operation of Load Control Switches.

- • Four quadrants Operation.
- • Must support minimum 4 TOU channels
- • Method of Communication (Bi-directional)
  - o Remote – RF, PLC, 4G, 3G, 2G, GPRS (on fallback mode) via HES
  - o Local – optical, RS232/485, Ethernet via BCS and HHU/CMRI

- The meter shall be of the surface mounting type and shall have terminals at the bottom.
- The insulation class of the meter shall be protection class II and rated impulse voltage shall be 6 kV minimum.
- The meter shall have minimum 20 years of life span and it shall operate within the stipulated error limits for full life span without any recalibration.
- Burden - 10VA per phase for voltage circuit, 4VA for per phase for current circuit without communication mode as per IEC Standard.
- Bi-directional Energy measurement.
- Net energy measurement.
- Measurement resolutions – minimum 0.01 kWh for Active Energy, minimum 0.01 kVARh for Reactive Energy.
- Calendar - Nepali Bikram Sambat (B.S.) calendar.
- Degree of protection IP54

**Electrical Requirements (CT Operated)**

| Type of Installation | Outdoor, encased with pilfer proof box of IP54 class |
|---|---|
| CT secondary | 5 A |
| VT secondary | **HT metering**<br>   110/√3 V (Phase to Neutral)<br>   110 V (Phase to Phase)<br>**LT metering**<br>   400/√3 V (Phase to Neutral)<br>   400 V (Phase to Phase)<br>The voltage range shall be 70 to +20% of the rated voltage. |
| Power Factor Range | Zero Lag – Unity – Zero Lead |
| Power Consumption | As per the relevant IEC Standards |
| Frequency Range | 50 Hz ± 5% |
| Earthing System | Solidly Grounded |
| Ingress Protection | Meter of IP 54 class |
| Starting Current | 0.1% of Ib |
| Number of TOU | 8 |

# Data Display Facility (Auto/Manual):

Data Display shall be in Four Modes-

- Auto Scroll Display Mode
- Manual Scroll with Push Button Mode
- Power-Off Mode
- High Resolution

**Data Display Facility (Auto/Manual):**
Data Display shall be in Four Modes-
- ➢ Auto Scroll Display Mode
- ➢ Manual Scroll with Push Button Mode
- ➢ Power-Off Mode
- ➢ High Resolution (Shall display energy values with resolution of 2 digits before decimal and 3 digits after decimal in push button mode)

**Data Display order for Smart Energy Meter shall be:**
- ➢ Auto Scroll Display Mode:
- ➢ Local Date
- ➢ Local Time
- ➢ Meter Serial Number
- ➢ Consumer ID
- ➢ Approved Load
- ➢ Instantaneous Voltage
- ➢ Instantaneous Current
- ➢ Power Factor
- ➢ Current Active Energy Import (+A)
- ➢ Current Active Energy Export (-A)
- ➢ Previous [1] month Active Energy Import (+A)
- ➢ Previous [1] month Active Energy Export (-A)
- ➢ Current Active energy (|+A|+|-A|) Combined Total
- ➢ Current Active Energy (|+A|-|-A|) Net Total
- ➢ Apparent MD (+) & occurring time Current Month
- ➢ Apparent MD (-) & occurring time Current Month
- ➢ Status Indicator for Meters' Module Cover Open with date and time (If module cover-open, should always display no matter module cover closed or not)
- ➢ Meter Status (Forward/Export)
- ➢ RSSI (Network Signal Strength) – as supported by communication module
- ➢ Error Code (as mentioned in Table 1 below)

The meter can display other parameters as required. These parameters should be displayed on the LCD/LED continuously for a period of 15 seconds on Auto-Scroll Mode. In case of power failure, the meter should display above parameters with push button.

**Manual Scroll with Push-button Mode**
- Local Date
- Local Time
- Meter Serial Number
- Consumer ID
- Approved Demand
- Instantaneous Voltage
- Instantaneous Current
- Power Factor
- Current Active Energy Import (+A)
- Current Active Energy Export (-A)
- Previous [1] month Active Energy Import (+A)
- Previous [1] month Active Energy Export (-A)
- Current Active energy (|+A|+|-A|) Combined Total
- Current Active Energy (|+A|-|-A|) Net Total
- Apparent MD (+) & occurring time Current Month
- Apparent MD (-) & occurring time Current Month
- Status Indicator for Meters' Module Cover Open with date and time (If module cover-open, should always display no matter module cover closed or not)
- Meter Status (Forward/Export)
- RSSI (Network Signal Strength) – as supported by communication module
- Error Code (as mentioned in Table 1 below)

Table 1 (Mandatory in case of GPRS/3G/4G/5G/e-SIM Communication Module):

| No. | Error Mean | Error Display |
|-----|-----------|---------------|
| 1 | All Good | Err 00 |
| 2 | Meter NIC Communication Failure | Err 01 |
| 3 | Modem Initialization Failure | Err 02 |
| 4 | SIM Not-detected | Err 03 |
| 5 | SIM Invalid | Err 04 |
| 6 | No GSM Network Coverage | Err 05 |
| 7 | GPRS Network Registration Failure | Err 06 |
| 8 | GPRS Registration Denied | Err 07 |
| 9 | No APN Configured | Err 08 |
| 10 | GPRS Connection Not-established | Err 09 |
| 11 | HES IP/Port Not-configured | Err 10 |
| 12 | HES Port Not-open | Err 11 |
| 13 | Any Key Mismatch b/w meter and NIC | Err 12 |

The meter's display should return to default display mode (continues auto-scroll) if push button is not operated for more than 10 seconds. (The order of display may be revised as per requirement of the utility)
The meter's display should return to default display mode (continues auto-scroll) if push button is not operated for more than 10 seconds. (The order of display may be revised as per requirement of the utility)

**Power-Off Mode:**
- Local Date
- Local Time
- Meter Serial Number
- Consumer ID
- Approved Demand
- Instantaneous Voltage
- Instantaneous Current
- Power Factor
- Current Active Energy Import (+A)
- Current Active Energy Export (-A)
- Previous [1] month Active Energy Import (+A)
- Previous [1] month Active Energy Export (-A)
- Current Active energy (|+A|+|-A|) Combined Total
- Current Active Energy (|+A|-|-A|) Net Total
- Apparent MD (+) & Occurring time Current Month
- Apparent MD (-) & Occurring time Current Month

In case of power failure, the meter should display above parameters with push button.

**4.1 Generic Profile Parameters;**
The meter should record and automatically PUSH all related parameters under various Generic Profiles as follows as (which can be changed or updated after contract signing) per defined time interval to HES/MDMS System;
- Load Profile 1 (OBIS Code: 01.00.99.01.00.255)
- Load Profile 2 - Instantaneous (OBIS Code: 01.00:99.128.00.255)
- Load Profile 9 (OBIS Code: 01.00:99.02.00.255)
- Monthly Billing Profile (OBIS Code: 00.00:98.01.00.255)

**Details Parameters List under Load Profile 1 (OBIS Code: 01.00.99.01.00.255);**
- Clock
- Profile Status 1
- Active Energy Import
- Active Energy Import Rate1
- Active Energy Import Rate2
- Active Energy Import Rate3
- Active Energy Import Rate4
- Active Energy Export
- Active Energy Export Rate1
- Active Energy Export Rate2
- Active Energy Export Rate3
- Active Energy Export Rate4
- Reactive Energy Import
- Reactive Energy Export
- Apparent Energy Import
- Apparent Energy Export
- Apparent MD (+) & occurring time Current Month

➤ Apparent MD (-) & occurring time Current Month

**Details Parameters List under Load Profile 2 - Instantaneous Parameters (OBIS Code: 01.00:99.128.00.255);**
➤ Clock
➤ Profile Status 2 (Load profile with period 2)
➤ Meter Number
➤ Voltage-Phase A
➤ Current-Phase A
➤ Active Power Import
➤ Active Power Export
➤ Apparent Power Import
➤ Apparent Power Export
➤ Reactive Power Import
➤ Reactive Power Export
➤ Power Factor
➤ Active Energy Import
➤ Active Energy Export
➤ Reactive Energy Import
➤ Reactive Energy Export
➤ Apparent Energy Import
➤ Apparent Energy Export
➤ Frequency
➤ Power OFF Duration in min
➤ Relay Status (On/Off)
➤ Meter Mode (Post/Prepaid)

**Details Parameters List under Load Profile 9 (OBIS Code: 01.00:99.02.00.255);**
➤ Clock
➤ Profile Status 9 (Load profile with period 9)
➤ Active Energy Import
➤ Active Energy Export
➤ Reactive Energy Import
➤ Reactive Energy Export
➤ Apparent Energy Import
➤ Apparent Energy Export
➤ Apparent MD (+) & occurring time Current month
➤ Apparent MD (-) & occurring time Current month

**Details Parameters List under Monthly Billing Profile (OBIS Code: 00.00:98.01.00.255);**
➤ Clock
➤ Active Energy Import
➤ Active Energy Import Rate1
➤ Active Energy Import Rate2
➤ Active Energy Import Rate3
➤ Active Energy Import Rate4

- ➢ Active Energy Export
- ➢ Active Energy Export Rate1
- ➢ Active Energy Export Rate2
- ➢ Active Energy Export Rate3
- ➢ Active Energy Export Rate4
- ➢ Reactive Energy Import
- ➢ Reactive Energy Export
- ➢ Apparent Energy Import
- ➢ Apparent Energy Import Rate1
- ➢ Apparent Energy Import Rate2
- ➢ Apparent Energy Import Rate3
- ➢ Apparent Energy Import Rate4
- ➢ Apparent Energy Export
- ➢ Apparent Energy Export Rate1
- ➢ Apparent Energy Export Rate2
- ➢ Apparent Energy Export Rate3
- ➢ Apparent Energy Export Rate4
- ➢ Active Energy (|+A|-|-A|) Net Total
- ➢ Active Energy (|+A|-|-A|) Net Rate1
- ➢ Active Energy (|+A|-|-A|) Net Rate2
- ➢ Active Energy (|+A|-|-A|) Net Rate3
- ➢ Active Energy (|+A|-|-A|) Net Rate4
- ➢ Active Max Demand Import
- ➢ Active Max Demand Import Date
- ➢ Active Max Demand Export
- ➢ Active Max Demand Export Date
- ➢ Apparent MD (+) & Occurring Date
- ➢ Apparent MD (+) & Occurring Time

**Details Parameters List under PUSH EVENTS (as supported by Communication Module);**

| Standard Event | | |
|---|---|---|
| Push OBIS: Class 7;0-0:99.98.0.255; Attribute:02 | | |
| Name | Event Code | Event Description |
| Standard Event | 6 | RTC Error |
| Standard Event | 18 | Firmware Activated |
| Standard Event | 19 | Firmware Update Failure |
| Standard Event | 30 | Parameter Program |
| Standard Event | 40 | TOU parameter modified |
| Standard Event | 131 | Monthly Billing Date and Time Changed |
| Standard Event | 216 | Low Battery Voltage of Internal Battery |
| Standard Event | 243 | Prepaid and Post-paid mode switch |

**Tamper Event**

| Push OBIS: Class 7; 0-0:99.98.1.255; Attribute: 02 | | |
|---|---|---|
| Name | Event Code | Event Description |
| Tamper Event | 40 | Terminal Cover Open |
| Tamper Event | 41 | Terminal Cover Close |
| Tamper Event | 42 | Magnetic Influence Detection Start |
| Tamper Event | 43 | Magnetic Influence Detection End |
| Tamper Event | 44 | Meter Cover Opened |
| Tamper Event | 45 | Meter Cover Closed |

**Relay Control Event**

| Push OBIS: Class 7;0-0:99.98.2.255; Attribute:02 | | |
|---|---|---|
| Name | Event Code | Event Description |
| Relay Control Event | 62 | Remote disconnection from HES |
| Relay Control Event | 63 | Remote connection from HES |
| Relay Control Event | 64 | Local Disconnection (once disconnection through power or current, need push every phase Current & Voltage and import/export active energy) |
| Relay Control Event | 67 | Approved Load Limit (in Amp) Changed |
| Relay Control Event | 68 | Local reconnection restored |
| Relay Control Event | 73 | Disconnect / Reconnect Failure |
| Relay Control Event | 76 | Disconnection cause of Tamper Issue |
| Relay Control Event | 110 | Relay Function Enabled (Changed into Mode-4 or Mode-6) |
| Relay Control Event | 111 | Relay Function Disabled (Change into Mode-0) |
| Relay Control Event | 112 | Threshold % of Load Limit Changed |
| Relay Control Event | 255 | Relay disconnect (any reason of relay disconnection) |

**Power Quality Event**

| Push OBIS: Class 7;0-0:99.98.4.255; Attribute: 02 | | |
|---|---|---|
| Name | Event Code | Event Description |
| Power Quality Event | 19 | Reversed Polarity Started |
| Power Quality Event | 20 | Reversed Polarity End |
| Power Quality Event | 156 | Overload Started |
| Power Quality Event | 157 | Overload End |

| Communication Event | | |
|---|---|---|
| Push OBIS: Class 7;0-0:99.98.5.255;Attribute:02 | | |
| Name | Event Code | Event Description |
| Communication Event | 156 | Signal Quality Low |

**Auxiliary Power Consumption:**
The active and apparent power consumption in the voltage and current circuits of the meter at a reference voltage, frequency, temperature and rated current shall not be more than that stipulated in Tables 1 and 2 of IEC 62053-21

**Accuracy Requirements:**
The percentage errors shall not exceed the limits for the relevant accuracy class given in Table 6 of IEC 62053-21.
Limits of error due to current and other influencing factors. The additional percentage error due to the change influencing factors shall not exceed the limit for the reference accuracy class given in Table 8 of IEC 62053-21.

**Starting and running with no-load**
The meter shall be fully functional within 5 seconds after a voltage is applied to the meter terminals. When a voltage is applied with no current flowing in the current circuit the test output of the meter shall not produce more than one pulse. The meter shall start and continue to register at current shown in Table 9 of IEC 62053-21.
Maximum error limit at 1% Ib, UPF should preferably be within +/- 2%.
For Voltage variation use of "between to 50% of Vref allowable error limit is ±4%".

**Active Energy:**
Meter measures, registers and displays active energy within rated accuracy class range. Meter measures total active energy as per IEC 62056-61
Presentation of these values on the display is programmable.

**Maximum Power:**
Meter measures, registers and displays maximum mean active power under all tariffs as per IEC 62056-61
Power integration period is initially 15 minutes.
This value is programmable with the following values: 1, 5, 15, 30 and 60 minutes and display of this value is easily accessible under manual display operation regime and remotely. Manual reset is not possible.

**Current Active Power:**
Meter measures and displays current active and reactive power of critical and non-critical loads separately in all four quadrants on request. The Single-Phase Smart Energy Meter must incorporate feature of Net-Energy Measurement. It should be suitable for Bi-directional Energy

Measurement with separate energy display in LCD and registration for Power injection and drawl from and to NEA Grid. The meter shall record and display Active & Apparent Power and Active & Apparent Energy in both Import and Export mode. There must be provision for Net Energy calculation for power Credits.

**Voltage Metering (Electricity Metering Quality):**
Meter measures and displays effective voltage value on request.
Maximum and Minimum Voltage:
Meter measures and registers maximum and minimum voltage value on the daily level.
Voltage Variation:
Meter registers the period in which the voltage has been beyond ±10% of rated voltage. 10-minute average voltage value is simultaneously monitored and in cases that 95% of 10-minute average voltage values for the last seven days are out of range of ±10% of rated voltage, or 100% of 10-minute average voltage values for the last seven days are out of the limits + 10% / -15% of rated voltage, corresponding information is entered into Electricity quality log.

**Under and Over Voltage:**
Under and Over Voltages Meter registers under-voltage/overvoltage occurrence event and termination of the latter. Vents are entered into a special event log (electricity quality log) with the date/time of event, with the capacity of at least 100 entries. Under-voltage and overvoltage thresholds may be adjusted. Initially: under-voltage = -20% Un, overvoltage = +15% Un.

**Current Metering:**
Meter shall measure and displays effective current value on request.

**Phase Presence:**
Meter shall display voltage presence on the connected conductor.
As a rule, voltage drop below the value of 50% of rated voltage is valued as the absence of phase voltage. This value is programmable, and it is initially 50%.

**Time and Date:**
Meter displays time and date as per Nepali Bikram Sambat (B.S.) Calendar from internal clock controlled by a quartz crystal oscillator. It should operate with accuracy as specified in IEC 62052-21. The nominal clock resetting function should be there (but be independent from all functionality of the meter).

**Battery Backup as Redundant Power Source:**
The meter shall have at least 1200mAH built-in battery and at least a port provision of external field replaceable battery (1200mAH) for future use in case of internal battery failure. It shall be a long-lifetime super lithium maintenance free battery catering to power down protection of clock, data and settings.
The life time of the battery shall be such that it performs evenly throughout the full life span of the meter under normal usage.
The battery should be capable of self-sustaining its original condition for 15 years without power.

**Display Power up in Absence of Mains Supply:**
The meter should have the provision of providing the display of billing parameters in absence of main supply. Press of push button should activate the display to facilitate hands free meter reading with auto-off provision.

**Additional Power Supply:**
Meter shall be provided with 2 unit batteries (1 inside meter and another with port provision as replacement battery) and a Super Capacitor as additional power source. The rated shelf life of battery shall be of 15 years. Super capacitor shall provide carry-over power for all normal power outages at least for 48 hours duration. Battery will work when super capacitor is discharged or when programmed meter is stored for extended period without electric supply. No auxiliary supply should be required for the meter.

Additionally, the meter shall have separate internal & external maintenance free replaceable battery (super Li-ion) of long life of 15 years with suitable Push Button arrangement for activation of display.

**Display:**
Meter shall be provided with a user-friendly display of information with easy navigation through displayed information. Presentation of metered values and characteristic codes shall be easily readable even in badly lit environment, as well as under direct lighting for which back light is needed.
Presentation of metered values covers minimum 8 (Eight) digits, The number of integer and decimal must be configurable. display shall at least be 4.5mm (Width) x 8.0mm (Height) for metered values.
LCD display operates in automatic, manual and self-check display regime. Transition between automatic and manual display operation regime is executed in a simple manner, e.g. by pressing the key/keys. Default display regime is automatic to which the display returns from manual display after corresponding idle period (keys are not pressed), which is programmable.
Under automatic regime, values of metered and registered values are shown cyclically. Individual value display period should be programmable and between 5 to 20 sec. Values presented on LCD display, their sequence and number shall be changeable (programmable). Initially, only accounting elements and current date and time are cyclically changed in the period of 8 sec on meter display.
Under manual display regime (value display regime based on selection), access should be enabled to the standard data menu (accounting data, current power, voltage, current, etc.). Values displayed in the standard data menu, their sequence and number shall be changeable (programmable) and independent from the setting for automatic display regime.
Self-check display regime is realized to visually verify the accuracy of symbol and character display on it (verification of proper operation of all LCD display elements), as well as basic meter functions.
The data should be stored in non-volatile memory (NVM). The non-volatile memory should retain data for a period of not less than 15 years under un-powered condition. Battery back-up memory will not be considered as NVM.

**Keys:**
The meter should have at least 2 button keys easily accessible on Top-Cover of Meter. One button key for menu scrolling for Key enabled menu scrolling functions, selection of desired menu, return to the previous menu level and return to automatic operation regime. The Second key button (MD Reset Key Button) should be for MD Reset function and Manual Disconnection & Re-connection of Relay function with provision to put Seal for unauthorized operation.

**Impulse (Test):**
The meter should have an optical impulse output via red LED diode. Characteristics of impulse terminals of the meter are realized according to the standard IEC 62053–31.

**Meters and DCU RAM Requirements:**

**Definitions**
The following definitions are valid for all Reliability, Availability, and Maintainability (RAM) purposes in the Specification for meters and DCs. The RAM parameters are characteristics of the meter/ DC design and production only when they are properly used and maintained.
**Failure** – Failure is any event where a meter/DC has stopped functioning, or exceeds its specification limits, and requires repair or replacement.
Failure Rate – The failure rate of a meter/DC is the number of failures per operating time unit. The system failure rate for the meter/DC will mean the sum of the failure rates of its components, i.e. $\lambda = \lambda_1 + \lambda_2 + \lambda_3 + \ldots + \lambda_n$.
MTTF – MTTF is the mean time between the meter/DC installation and operation, and the first failure.
**Reliability** – Reliability is a design characteristic defining the ability of a product to perform satisfactorily. Reliability is the probability that a meter will perform without failures, for a pre-defined period of time. MTTF is a reliability parameter, in accordance with definitions of IEC 60050-191. i.e. Life Length – Life length of a meter/DC is the time until the first failure in operation.
**Maintenance** – Maintenance is any action taken to replace a faulty meter/DC with a properly working one, after a failure, and test the operable condition of a replaced meter.
Maintainability – Maintainability is a design characteristic defining the ability of an item to be replaced quickly and checked for its operable condition after a failure.

**RAM requirements**
The Bidder is required to provide with meters/DC with the following RAM properties:
**Reliability**
Operational TTF (time to first failure): At least 10 years.
Operational service life time: At least 10 years, without the need for maintenance or recalibration.
**Maintainability** – The meter/DC will be "preventive maintenance" free for its entire life length.

**RAM Declaration**
A RAM Declaration shall be provided for each of the meter/DC components. The following RAM information shall be submitted to NEA with the technical proposal:

The minimum guaranteed MTTF

The life length values of the proposed meters/DC.

The sum rate $\lambda$ total and these components values as predicted and verified (tested) will be reflected at MTTF state.

The historical RAM field data of proposed meters/DC, for all installed meters/DC (identical to the ones proposed), at all sites, supplied during the last 5 years. The RAM report should include specific model type, and years of the collected data.

Reliability prediction report according to IEC 62059-41.

Information about RAM activities and optimization in the manufacturing plants concerning the proposed meters/DC including:

> Criticality (long supply time, high price, short life length, high failure rate, single supply source, sensitive or vulnerable materials, etc.
> Latent failure rate ( ), and induced failure rate (caused by human).
> Turnaround Time (door to door).
> Quantity in service.
> Recommended "probability of no shortage" (spares availability) on shelf Cost
> The Bidder shall state the rationales for his above-mentioned declarations (usage/tests/analysis/estimation).

**Climatic Conditions:**

The meter supplied against this specification should be suitable for the satisfactory continuous operation under the tropical conditions. Meters should be capable of maintaining required accuracy under hot tropical and dusty climate.

The meter shall meet Dry Heat/Cold/Damp heat cycle test requirement as per relevant IEC compliances.

**Mechanical and Constructional Requirements**:

The Meters shall be of rugged construction to ensure reliable operation. The meter shall have an insulated case which shall be sealed in such a way that the internal parts of the meter are not accessible to unauthorized persons.

Meter shall be designed and constructed in such a way so as to avoid causing any danger during use and under normal conditions. However, the following shall be ensured:

> Personal safety against electric shock
> Personal safety against effects of excessive temperature
> Protection against spread of fire
> Protection against penetration of solid objects, dust and water

All meter housing parts, including the terminal shall be made of material resistant to mechanical impact, humidity, UV radiation and self-quenching characteristics in accordance with the requirements indicated by IEC 62052–11 standard.

The meter shall be designed and manufactured using SMT (Surface Mount Technology) components. The meter PCB should be wireless to avoid improper and loose connections/ contacts due to inter-connecting wires. This feature is mandatory in proposed meters.

All insulating material used in the construction of meter shall be non-hygroscopic, non-ageing and of tested quality to ensure higher reliability, longer life and sustained accuracy. All parts that

are likely to develop corrosion shall be effectively protected against corrosion by providing suitable protective coating.

The meter shall have an operation indication device such as a blinking LED / LCD given type indication. The operation indicator shall be visible from the front window and capable of being monitored conveniently with suitable testing equipment. The digits size shall be minimum 8.0mm x 4.5mm.

The meter shall conform to the degree of protection IP54 of IEC529 for protection against ingress of dust, moisture and vermin.

The meter shall be supplied with a transparent extended terminal block cover (ETBC). The clearance from bottom of terminal cover to terminal block shall be more than 40mm.

The meter base shall be manufactured from high quality industrial grade material viz. Polycarbonate with 10% glass filled which shall meet mention properties to ensure higher reliability and long life of the meter case.

Meter's case material should be polycarbonate and it should be fire, heat and ultra violet radiation resistant as per IEC62052-11.

All parts of the meter should be resisted against mechanical stroke and shake during the transportation as per IEC62052-11.

The meter base, terminal compartment, meter cover and terminal cover shall be of high grade non-hygroscopic, fire retardant, low tracking fire resistant, reinforced poly-carbonate which shall form an extension of the meter case and shall have terminal holes and shall be of sufficient size to accommodate the insulated conductors & meet the requirement of IEC standards.

The meter cover shall be made of polycarbonate and shall be one integral unitor ultrasonic welded type. The terminal cover shall be transparent and extended type with provision to seal and should have separate seals.

The wiring terminals shall be protected by a sealable terminal cover and the terminal cover shall be made of an insulating material.

The terminal cover shall be of extended type with "U-Shaped" cut-out so that input cables can be easily inserted to connect into meter. Provision shall be made to seal the meter cover and terminal cover separately.

No permanent deformation of the case is allowed for life time period of 15 years. Meter case material should not deteriorate over the guaranteed life span of the meter. UV protected materials should be used.

The meter cover shall have a continuous gasket between the base and the cover (fitted in a recessed groove in the cover) to prevent entry of dust, water, insect etc. so as to achieve degree of protection not less than IP54. Gasket shall not be detached when meter cover is removed from the base.

The meter should be capable of providing phase to neutral protection up to 265 V for 4 hours.

The meter cover and base shall be suitably shielded with metallic material so as to protect the meter from adverse effect of AC/DC Abnormal external magnetic field.

The terminal block, the ETBC meter cover and meter base shall ensure reasonable safety against the spread of fire. They shall not be ignited by thermic overload of live parts in contact with them.

The terminals shall be clamp type and have suitable construction with barriers and cover to provide firm and safe connection of current and voltage leads of stranded copper or galvanized copper conductors or copper reducer type terminal ends (thimbles). The manner of fixing the conductors to the terminal block shall ensure adequate and durable contact such that there is no

risk of loosening or undue heating to use with Aluminium or Copper Input Power Cables. Screw connections transmitting contact force and screw fixing which may be loosened and tightened.

The meter shall be compact in design. The entire design and construction shall be capable of withstanding stresses likely to occur in actual service and rough handling during transportation. The meter shall be convenient to transport and immune to shock and vibration during transportation and handling.

All parts that are likely to develop corrosion shall be effectively protected against corrosion. The construction of the meter shall be such as to be sealed independently and prevent unauthorized tampering.

The meter shall meet the mechanical requirements as per compliance with IEC standards.

The meter should be fitted with C.T. or Shunt for measuring current in the phase and neutral element with proper isolation. The C.T. or Shunt used in current circuit must be of high quality having high thermal stability and temperature co-efficient. The shunts should be E-Beam / Spot welded.

The load/VT/PT terminals should remain inside the Meter Main Body which should not be accessible externally after removing the Meter Terminal Cover. This point is very crucial and mandatory to be qualified during Sample Testing Process.

The meter should have an indication in its' display and cut-off relay for output load if meter top-cover is removed even in power-off condition and it should not disappear even if cover is fitted.

The meter should be compatible to work Post-paid as well as in Pre-paid mode. The meter shall have M-bus interface ready to connect Customer Interface Unit (CIU) in case meter is using prepaid mode.

The Meter Terminal should resist the heat dissipated for more than 20% of the heat produced by the Rated Current of the said Meter. (Copper cable logs should be compatible to the meter terminals.)

**Test of Mechanical requirements**

The Type Test shall be performed at a reference voltage at a reference frequency of 50Hz. The Type test Certificates shall be submitted in complete form as furnished by the testing Authority. Incomplete Type Test Certificates of parts of Certificates will not be considered. ((IEC 62052-11)

- ➢ Vibration test
- ➢ Shock test
- ➢ Spring hammer test
- ➢ Tests of protection against penetration of dust and water
- ➢ Test of resistance to heat and fire

**The Type Test Certificates shall clearly indicate the following**;

- ➢ Name, Address and Country of the Testing Authority.
- ➢ Date of Testing.
- ➢ Name of Equipment Type Tested.
- ➢ Number of pages of the Type Test certificates.
- ➢ Manufacturers identify/Catalogue Reference Number etc.
- ➢ Basic Parameters.

- The Standard to which the equipment Type tested.
- Comments and Observations of the Testing Authority.

**Resistance to Heat and Fire**
The terminal block, the terminal cover and the meter case shall not ignite by thermal overload of live parts in contact with them and they shall meet the tests stipulated in Clause 5.8 of IEC 62052-11

**Protection against penetration of dust and water**
The metering equipment shall be suitable for indoor use and conform to the degree of protection of IP54 as per IEC 60529.

**Influence of Supply Voltage**
Voltage Range:
The normal operating voltage range of the meter shall be as stipulated in and the permissible error due to voltage variation shall conform to the table 7 of IEC 62052-11.

**Voltage dips and short interruptions**:
Voltage interruptions shall not produce a change in the register as stipulated in Clause 7.1.2 of IEC 62052-11. When the voltage is restored, the meters shall not have suffered degradation of the meteorological characteristics.

**Influence of short time over current**:
The meters shall not be damaged by short time over currents and the meter shall perform correctly when back to its initial working conditions and the variation of error shall not exceed the value indicated in Table 3 of IEC 62053-21.

**Influence of self-heating**:
The variation of error due to self-heating shall not exceed the value given in Table 4 of IEC 62053-21.

**Influence of heating**:
The temperature rise at any point of the external surface of the meter shall not exceed 25K with the ambient temperature at 40o C. Under normal operating condition the electrical circuits and insulation shall not reach a temperature which might affect the operation of the meter.

**Insulation**
The insulation of the meters shall withstand an impulse voltage of 10 kV peak as stipulated in clause 7.3.2 in IEC 62052-11, power frequency withstand voltage of 4 kV as stipulated in clause 7.4 in IEC 62053-21and surge immunity voltage on main lines of 4kV as stipulated in clause 7.5.6 in IEC62052-11.

**Electromagnetic Compatibility**
Meter shall meet norms required by IEC 62052-11 and IEC 62053-21 standards.
Immunity to electromagnetic disturbance the meter shall be designed in such a way that conducted or radiated electromagnetic disturbance as well as electrostatic discharge do not damage or influence the meter.
The meter shall not generate, conduct or radiate noise which could interfere with other equipment.

**Sampling Rate and Derivation of Basic Measurable Quantities:**

The actual supply wave of related voltages and currents shall be sampled out at the rate of minimum 3000 samples per second and shall provide integrated values of each actual voltage and current (available on display in push button mode) while deriving actual basic active (cosine part measurable component) energy (with respect to relevant voltage wave and current wave) even under presence of harmonics.

The meter shall have internal Real Time Clock with the backup of a Lithium maintenance free battery of minimum shelf life of Fifteen (15) years for operation of the time clock. The Real Time Clock shall be based on Quartz crystal timer so as to make it independent of line frequency variations.

**Meter's Communication & CMRI/HHU Device with Meter Reading Software:**

Meter display should have eight digits (the minimum size of each digit 4.5×8.0 mm) and view angle of 15º upward directions and 60º in other directions. Ability to display all measured quantities or desired quantity automatically or scrolling through the button on the meter as follows:

Active Energy Import & Export in each tariff

**Current Tariff**
- ➢ Max. Demand in each tariff and also the highest Max. Demand with exact time & date Time and calendar date as per Nepali Bikram Sambat (B.S.) Calendar
- ➢ Meter Serial number
- ➢ Battery charge condition (meter should indicate the battery status and display it on LCD 6 month before complete discharge also battery status should be readable by meter read)
- ➢ Relay Status
- ➢ All parts of item 3 (including instantaneous quantities and cumulative energy values and also maximum demand in all tariffs with time & date indication).

Meter should have capability of display and record of Max. Demand with ability of configuration of Max. Demand time interval calculation. Max. Demand should be measured at least in three integer and two decimal digits.

LCD should display measured items in OBIS Codes and relevant standard, Symbols for Active Tariff & Quadrant, Active & Missing Phase Voltage, Forward/Reverse Energy Arrow, Battery Charge Level Status, Relay Status, Data Reading & Transfer, Signal Level for GPRS (if modem is GPRS Modem).

Meter should have Optical Port with baud rate of 9600 bps for local read and configuration, according to IEC62056-21, Mode-E and HDLC.

At least 1000 set of Hand-Held Unit (HHU) or Common Meter Reading Instrument (CMRI) Device with required Microsoft Windows or Android/IOS OS with 1000 sets of compatible Optical Probe Cables and specifically designed & developed to read/download meter data from proposed meters using Optical Probe and then upload to AMI/HES/MDMS Server via its' own GPRS/3G/4G modem in the event when RF/GPRS/PLC connectivity is not available at meter site, should be provided.

Meter should have active RS232 port for remote communication to fulfil AMI/HES/MDMS system requirements (this port should be physically accessible for authorized person and located on meter base).

This port should be Screw Terminal type or RJ12/RJ45 and should be easily installed & marked properly, and also wires should not be contacted directly to this port by screw.

Communication Protocol should be HDLC/Mode-E and DLMS/COSEM-TCP/UDP Wrapper Protocol according to DLMS/COSEM, IEC62056.

OBIS indication according to IEC62056-61.

**Anti-Tampering Features:**

The meter shall continue recording correct energy within the permissible limits of error of relevant IEC under any one or combinations of the following conditions:

The meter shall continue recording correct energy within the permissible limits of error of relevant IEC under any one or combinations of the following conditions.

In case in-put/out-put terminals are interchanged. LCD indicator (reverse current) should also glow under this tamper condition.

If the load current does not flow back to meter and instead current is drawn through local earth

Under neutral missing condition with balanced load.

**Current Reversal:** The meter shall be capable of recording energy correctly even if the input and output terminals are interchanged

The meter shall work correctly even in absence of neutral as per IEC 62052-11:2003. Accuracy in between 60% Vref to 50 % Vref but with loading of 5% to 120% must be maintained within +/- 4%.

Meter should record energy within maximum error of +/- 4% on injection of DC, pulsating DC (7-10 Hz), Chopped AC in Neutral. However meters which are immune or maintain better accuracy, will be preferred. Maximum chopping for AC injection will be 25% to 30% at peak end.

The registration shall not be affected more than +/- 4% if high frequency (60-100 Hz). A.C. Voltage w.r.t. earth is applied to the meter neutral.

Meters which are immune or will maintain better accuracy will be preferred.

The meter should be immune to Electro-Static Contact discharge: 8kV; Air discharge: 15kV induced by using frequency-generating devices having very high output voltage.

**N.B.**:-Tests in this respect will be conducted by using commonly available devices and and meter should maintain accuracy after the test under this condition. During and after these tests, the meter should record energy correctly within the specified limits of errors.

**Beyond Contact discharge:** 8kV; Air discharge: 15kV the meter should record tamper if not immune. Similarly, the meter shall be capable of recording; occurrences and restoration with date and time i.r.o. the following tamper conditions:

**Power on/off:** The meter shall be capable to record power-on/off events in the meter memory. All potential failure should record as power off event.

**Magnetic Influence**: The Meter shall be capable of detecting and recording of presence of abnormal magnetic influence (not more than 500mT magnetic) near the meter, if the magnetic influence affects the meter functionality. The meter should record energy at Imax on account of magnetic influence or disconnect the relay directly. Separate legend for magnet event shall be made available on LCD. This legend shall remain in on state till meter reading so that it shall come in to notice of meter reader.

**Over Current:** When load condition i.e. Line current at any phase goes more than defined limit, this shall be detected as Over current condition and relay shall be cut-off power to load as defined.

**High and Low Voltage**: The meter should detect under and over voltage events respectively if voltage falls / rise from defined limits.

**Meter Cover Open:** The meter shall be able to detect meter cover open occurrence event if cover is opened in mains on or off condition. Separate legend for cover open event shall be made available on LCD. This legend shall remain all time no matter this event end or not.

A separate register is additionally required for defraud energy registration.

The meter shall be factory calibrated through software and no modification of calibration shall be possible at site by any means what-so-ever.

Meter should withstand 440V for a period of 30 minutes between phase and neutral terminals without damage and shall continue to record energy correctly within its' accuracy class, after restoration of normal supply.

In case meter top-cover is opened, the same should be recorded as tamper event with date & time stamping and relay shall be immediately dis-connected permanently supply to load. Icon on Display should be displayed.

In case of Magnetic Influence, meter should run into Punishment Measurement Mode (at Imax) which means to use Un-Voltage, Max Current (Imax) and 1.0 Power Factor or disconnect relays immediately. However, in case of meter top-cover open detection, relays should get disconnected immediately. The disconnected relays should be reconnected only through existing AMI/HES/MDMS Software System of NEA.

The meter shall continue recording energy under any temper condition and would log the event and send alarm at existing AMR (MDA & MDM) after detection of the defined theft features as per relevant IEC standards.

The meter should detect and record physical tamper attempts (fraud and violation) and inform the central system through communication port. Some of these tamper attempts are as follows:
Big Magnetic field [lower than 500mT (50X50X50mm)] meter accuracy class should not affect and can record related events.  Meter should not be failed to magnetic fields up to 500mT.
  ➢ Terminal and Meter cover removal

- ➢ Partial Earthing
- ➢ Inverse Current
- ➢ Changing of input Phase & Neutral and not utilization of network neutral

Meter should record following events with their exact time & date and it should be possible to read them remotely.
- ➢ At least 10 recent Magnetic Tamper
- ➢ At least 10 recent meter cover removal
- ➢ At least 10 recent terminal cover removal
- ➢ At least 10 recent energy inverse
- ➢ At least 10 recent meter turn off (power disconnection)
- ➢ At least 10 recent remote connect/disconnect order
- ➢ At least 10 recent meters connect/ disconnect due to load limitation
- ➢ Meter reprogramming
- ➢ Tariff change
- ➢ Time & Date change
- ➢ Access record with both correct and incorrect passwords
- ➢ Meter should have software serial number which is located in internal memory of meter and should be completely protected by meter. Stored programs and registers should have Full tamper and fraud protection.

## Disconnection and Reconnection Mechanism:

### Disconnection Mechanism:
Disconnection switches shall be operated by the meter itself, without any command from external, in case of over drawl of current, voltage sag and swell, power factor, temperature and the settings for such operations shall be configured by the utility from remote. Each operation of the switches shall be logged by the meter as an event with date and time stamp. The cumulative no. of such operations shall also be made available.
The brief technical particulars of this disconnector / relay are furnished below:-
Operating Voltage range: 130 V to 250 V
Operating Current range: 20mA to 60/100A
Short time over current withstand: 2500 A for 10 ms capacity
Maximum switching power: 15 kVA
Power consumption: less than 4.0 VA
No. of poles: 1 in P-N (for 1 phase)
Life: 100000 operations
(1 operation = 1 make & 1 break)

### The disconnection mechanism is as follows:

The relay re-connection shall be decided by meter locally when consumption is more than the programmed limits. It will try to re-connect the load up to 3 times, with 5 minutes interval.
If the consumption is still more than the programmed limits, it will lock out and wait for 30 minutes (lock out period).

If the consumption is still above the limit, the procedure as defined above in i) and ii) shall be repeated. The number of re-connection attempts, time interval between reconnection and lock-out period shall be programmable by the utility.

**Reconnection Mechanism:**
Reconnection shall normally be done from AMI (MDA & MDM) or HES/MDMS System. In case of failure of communication AMI (MDA & MDM) or HES/MDMS System, reconnection shall be possible through CMRI/HHU locally and the same shall be password protected. Relay for connect/disconnect shall comply all relevant requirements of IEC Standards.

**Switching / Relay Element Details:**
> ➢ The switching element shall have the following specifications:
> ➢ Should be Impulse relay or Latching relay
> ➢ Contact Specification according to IEC62055-31 and IEC61810-1:
> ➢ Standard rated current 1.2 times of meter Imax,
> ➢ Maximum switching voltage at least 265V,
> ➢ AC short circuit current (Utilization Category) – UC2.
> ➢ Insulation strength: Contact to contact 2.0 kV, Coil to contact 4 kV,
> ➢ Impulse strength Contact to contact At least 4 kV, Coil to contact At least 8 kV.
> ➢ Insulation Specification should be as per SP-1618 standards.
> ➢ Tamper protection against magnetic DC fields according to IEC 62053-21.
> ➢ The breaker shall be able to withstand at least 10000 open/close cycles at full load, without degradation of breaker and meter performance. The power breaker performance shall be in accordance with IEC 62055-31.

Additionally, the meter shall have an Auxiliary Relay inside the meter to disconnect the non-essential power loads for demand side management, with the use of external contactors. The operation of the extra relay shall be controlled from the remote with the help of software. The extra relay rating shall be either 2A/5A.

**Time & Date:**
The accuracy of meter's clock should be 0.5 second per day in 23ºC and 0.15 second change against 1ºC change per day as per IEC 62054-21.
Meter should have Nepalese Calendar including Leap year, Day light saving time, summer and Winter Clock and Tariffs for Normal days, Weekend, Public Holidays.
Note: Nepalese Calendar should be readable on each meter interface and this capability should be proved by the bidder on each meter interface. Also testing method of this capability should be provided by the bidder.

**Data Communication Module and related Features:**

The meter shall be provided with integrated inbuilt Plug-In Type Cellular RF/GPRS/PLC modem which should be able with IPv4, IPv6 and IPv4v6 protocols support for communication of the measured/collected data as per the guideline document for DLMS/COSEM energy meters. Adding or exchanging the communication module should be done without turning off the meter. Meter must be compatible with multi-communication module support.

The following features shall be provided;

The meter shall have an infrared Optical interface module to enable the use of a RS-485 or USB compatible Optical Probe in compliance with IEC 62056-21. The Optical port shall allow bi-directional communication with a Hand Held Unit (HHU)/CMRI for rapid, error free electronic data transfer using the DLMS/COSEM protocol as well as IEC 62056-21. The Optical port shall have magnetic adhesion ability to configure the meter, read all the register values and load profile data.

The modem must support data exchange using DLMS/COSEM-TCP/UDP Wrapper Protocol/Wrapper Protocol Data Unit (WPDU) as mentioned in Edition 9 of the Green Book, DLMS/COSEM Architecture and Protocols.

The modem should be hot-pluggable design to plug-out or plug-in to modular slot when meter is in power-on mode.

The modem should have inbuilt Super Capacitors to provide backup power to modem for at least 5 minutes when meter is power-off so that modem/meter can push data to HES System easily. It is strictly prohibited to use any type of Battery instead of Super Capacitors inside modem to provide required backup power.

The meter should push real-time outage alert & configured tamper alerts to HES/MDM Software.

The communication between meters and HES/MDM Server should be handled in an intelligent way to enable maximum success rate. Meter should send only missed or leftover data incase communication breaks/fails in between data transfer process.

There shall be provision to set the meter into Online mode for viewing real-time data in HES/MDM in interval of 1/5/15 minutes. In case of non-communication or communication fail after online mode is enabled, meter should store at least 100 intervals of instantaneous data & push the same once communication is restored.

The communication technology whichever used should support for remote configuration of parameters like APN name, destination IP, Interval time for instantaneous data, complete data virtually every required configuration shall be done remotely.

The meter should be capable to communicate requested data as per programmed interval and shall support remote configuration including remote firmware upgrade for meter and modem.

The meter should detect as well as resolve abnormal & tamper events while storing the same with alert to NEA official via email and SMS.

The meter should support remote load management by sending load curtailment signals that can be direct display/SMS/Web Application.

The meter should provide on-site communications indication with the HES/MDM and shall support self-discovery and self-registry functionality with HES/MDM System.

The meter/HES System shall support On-demand remote polling to determine whether the supply is open or closed/whether meter is energized or not. The meter shall provide clear local visual indication of the status (open/closed) of the supply, consumption, last bill details.

The meter/modem/DCU should support various direct SMS Commands from authorized Mobile Dialing Numbers (MDN) to enable read & write functions for various essential parameters and settings related to Consumer Information, Communication Information, Energy and Billing Information, Meter Information etc. to any meter as needed, so that NEA can change required parameters values by sending SMS as well as NEA/Consumer can get Energy related data like

Instantaneous Energy Information, Billing Information by sending SMS to Mobile Dialing Numbers (MDN)/SIM Number used in the Smart energy meter. If the meter had RF communication module and communicates with HES via DCU, then DCU must support mentioned direct SMS Commands to read and write on any meter connected with the respective DCU. However, If the meter has GPRS/3G/4G communication module and communicates with HES directly over GPRS/TCP, then meter must support mentioned direct SMS Commands to read and write on it.

This function makes NEA Branch Offices very easy to read/get Meter Information, Consumer Information, Billing Data from any specific meter by sending SMS for manual billing process or change parameter settings in the Meter in the event when communication signal remains weak or disruption due to any reason.

It must support & execute Pre-defined Set of SMS Commands from authorized Mobile/SIM Numbers to send back various Data frames like Meter No, Current Nepali Calendar Date & Time, Telecom Operator Name, Working Mode of GPRS with Signal Level, Instantaneous Electrical Parameters, Meter and Modem Firmware Version, Monthly Billing Parameters, Consumer ID, Approved Load, IP Address & Port, Admin Number for Write Functions etc., back to SMS senders' Mobile Number.

The communication module used in meter or DCU should support incoming Voice Call so that power-on/off status of meter can be detected remotely by initiating call using Mobile phone to SIM Mobile Dialing Number (MDN) used in the meter/DCU. It should give Busy Tone during power-on mode when it receives a call.

The meter/DCU shall capture and send telecom related parameters like MSISDN, MCC, MNC, LAC, Cell ID, RSSi/CSQ Values (in case of GPRS module) to HES.

The modem should be connected with external type high gain antenna (3dBi or more) with at least 0.5 meter coaxial cable and SMA connector if GPRS/RF modem is to ensure meter will get required GPRS/RF signal strength for smooth and un-interrupted operation.

The communication part of the meter is designed so as to enable simultaneous communication of the meter through all meter interfaces, without their mutual interference, and particularly without any effect on the metering part of the meter.

Direct connection with Laptop/CMRI/HHU when necessary to access the meter/meter parameters directly.

Communication ports shall not be affected by any type of injection /unauthenticated signals.

The bidder should provide Base Computer Software for Microsoft Windows OS, Mobile APP for Android/ IOS based Mobile Phone or HHU or CMRI required for local reading and programming & integrate. The bidder shall provide the Communication protocol, Firmware, Data-model, APIs etc., applied on meter.

The meter shall be capable of executing instructions from Base Computer Software for Microsoft Windows OS, Mobile APP for Android/IOS based Mobile Phone or HHU or CMRI only after due authentication through protected two level passwords (OTP), for the following:

Change in integration period.

Change in automatic re-setting for billing data date & time.

Meter should have provision for eight time zones as per ICS, however it should be configurable. So that it shall be modified as per the requirement up to eight zones and same should be recorded/ displayed.

The meter shall thereafter communicate above information while off-loading the data to computer with either relevant billing quantities or relevant energy audit/load survey data.

**33.2) Specification of RF/PLC Communication Module for Meter**

RF module should be designed for extremely robust communication based on reliable and highly secured connections between devices it is applied frontal of single-phase /three-phase meter slot. It is mainly used for meter to provide electricity information collection to HES system via DCU or Gateway.

The communication system of RF module shall be high-reliability, anti-interference, and self-healing communication and adaptive mesh network.

The RF communication technology should follow open standards that shall be interconnected by multiple manufacturers, the RF module should support IEEE802.15.4 Standards and WiSUN FAN protocol.

The RF communication module should be self-adapting mesh network, support auto-registration to join the network and IPv6.

The RF communication module support channel hopping (FHSS) and handle 10 hops from root of the mesh tree.

The RF communication module support flexible networking organization

The RF communication module shall support 50kbps/ 150kbps/ 300kbps.

The RF communication module support security features, include AES128, PKI authentication and authorization and key management.

The RF communication system shall support at least 10 depth of router, the communication distance of each level must be at least 150~300 meters supporting at least 1000 nodes/meters.

The RF communication module should support the power outage alarm function so that when the meter becomes power-off, it should automatically report a power outage event to HES.

The RF communication module shall Support dynamic routing mechanism, automatic repair of failed communication path.

The RF communication system Data link layer shall support data re-transmission mechanism with three modes: unicast, local broadcast, and network-wide broadcast.

The RF communication module must have its' own reliable microcontroller (MCU) used as the main chip, designed for extremely robust communication based on reliable and highly secured connections between devices.

The RF communication module must be designed and built to be resistant to overvoltage as well as incorrect meter connection to the network, to the same extent to which the meter is resistant to other potentially disrupting causes (such as atmospheric discharge, irregular connection, neutral conductor disconnection, one or two phases disconnection etc.). During disrupted network conditions, module functioning shall not be conditioned.

The RF communication module must have its' power supplied from the meter.

The communication distance between meters and data concentrator should cover 300m to 1000m via re-transmission. The communication distance between two nearest meters shall be up to 300m.

When the new meters are installed, the meter number shall be read via RF communication module and be sent to the DCU/HES automatically.

The events alarm produced by smart meters shall be sent to the DCU/HES automatically through the RF communication.

The RF communication module should Self-organized networking and realize the networking automatically. No manpower should be needed for setting-up the parameters on site.

The data relay/route transmission between meters and gateways/data concentrators should be realized by RF communication module automatically. Every RF communication module shall realize the data relay/route retransmission, no manpower should be needed.

The RF module must be equipped with the watchdog for execution of RF module hardware reset. If the module remain inactive for an extended period of time (time should be set as parameter), all communication parameters located in the module at the moment of reset must be saved.

The RF module should support power outage report or last gasp alarm.

The RF communication at application level must be compliant with the DLMS/COSEM specification.

The RF module should support firmware update via HES.

## Battery Type & Life:

(i)    The battery shall be High Quality Lithium-Ion with guaranteed life of 15 (Fifteen) years.

## Connection Diagrams, Phase Sequence and Terminal Marking:

Every meter shall be indelibly marked with a diagram of connections and this diagram shall also show the sequence for which the meter is intended, permanently pasted (manufactured from good quality plastic sticker material) on the inside of the extended transparent terminal cover.

## Guarantee:

The Meter shall be guaranteed for the period of 5½ years from the date of commissioning of meter. Meters found defective/ functioning abnormally / not functioning at all **(whatever the reason may be)** within the above guarantee period shall be replaced / repaired by the supplier free of cost within one month of receipt of intimation. If the defective meters are not replaced/ repaired within the specified period above, the NEA shall recover an equivalent amount plus 15% supervision charges from any of the bills of the supplier.

## Type Tests:

**Type Test:** The offered meter shall be type tested from one of the following Internationally Recognized Institutions/National Metrological Laboratories in accordance with relevant IEC Standard with latest amendments:

a. ASTA Certification Services (UK) or National Meteorological Laboratory in UK, accredited to Western European Legal Metrology Corporation.

b. CESI (Centro Electrotecnico Sperimentale Italiano S.P.A) or National Metrological Laboratory in Italy, accredited to Western European Legal Metrology Corporation.

c. ESEF (Ensemble Des Stations D' Essais a' Grande Puissance Francaises) or National Metrological Laboratory in France, accredited to Western European Legal Metrology Corporation.

d. B.V. KEMA (KEMA) or National Metrological Laboratory in Netherlands accredited to Western European Legal Metrology Corporation.

e. National Metrological Laboratory in Japan, accredited to National Laboratory Accreditation System in Japan.

f. National Metrological Laboratory, accredited to American Association for Laboratory Accreditation.

g. The type test from other internationally recognised independent meter test laboratory, such as PTB, Germany; PTP, Austria; NMI, Holland; Falcon Test Lab, SGS(English Version only) UK, Singapore; Ofgem (formerly known as 'Offer"), Ireland and other test lab recognised and approved by ANSI (American National Standards Institute) may also be acceptable.

The type test report for the offered type shall not be more than 5 (five) years old. A Notarized Copy of the Type Test Certificate with Report with results shall be enclosed with the offer. Type test of the meter manufactured has to be carried out in the above mentioned labs in the presence of NEA's representative before delivery of the meters.

# List of Components Makes for Smart Energy Meter

The meters shall be designed and manufactured using SMT (Surface Mount Technology) components as mentioned below in table, except for power supply components, LED/LCD etc., which are PTH/STN type. All the material and electronic power components used in the manufacture of the meter shall be of highest quality and reputed makes so as to ensure higher reliability, longer life and sustained accuracy.

| S. No. | Component Functions /Features | Requirements | Make/Origin |
|---|---|---|---|
| 1. | Current Element | E-beam/ Spot welded shunts shall be provided in the phase element and C.T. in the neutral. Alternatively, both the current elements (phase & neutral) shall have Shunts with proper isolation. | Any make or Origin conforming to IEC |
| 2. | Measurement Chips | The measurement chips used in the meters should be with the Surface mount type along with the ASICs. | Analog Devices, Cyrus Logic, Atmel, ST, National Semiconductors, NEC, NXP, Texas Instruments, Phillips, Teridian, Hitrendtech, Simens, Infineon, Toshiba, Renases, Renergy, Hitachi, Intel, Maxim |
| 3. | Computing Chips | The computing chips used in the meter shall be with the Surface mount type along with the ASICs. | Analog Devices, AMS, Cyrus Logic, Atmel, ST, National Semiconductors, NEC, NXP, Texas Instruments, Phillips, Teridian, Hitrendtech, Simens, Infineon, Toshiba, Renases, Renergy, Hitachi, Intel, Maxim |
| 4. | Memory Chips | The memory chips shall not be affected by external parameter like sparking, high voltage spikes or electrostatic discharges. Meter shall have non-volatile memory (NVM). No other type of memory shall be used for data recording and programming. (The life of the NVM is highest). There shall be security isolation between metering circuit, communication circuit, and power circuit. | Atmel, Teridian, National Semiconductors, Texas instruments, Philips, ST, Microchip, Spanson (Fujitsu), Ramtron, Macronix, Onsemi, Hitachi, Renesas, Fudan, ROHM, Siemens. |

| 5. | Display Module | a.) The display modules shall be well protected from the external UV radiations.<br>b.) The display visibility shall be sufficient to read the meter mounted at height of 0.5 meter as well as at the height of 2 meter (refer 3.2 d for viewing angle)<br>c.) The construction of the modules shall be such that the displayed quantity shall not disturbed with the life of display (PIN type).<br>d.) It shall be trans- reflective HTN {HTN - Hyper Twisted Nematic (120 $Â°$)} or STN {STN – Supper Twisted Nematic (160$Â°$)} type industrial grade with extended temperature range. | Bonafied Technologies, Displaytech, E-smart, Advantek, Jebon, Hitachi, Sony, L&G, Union Display, Tianma, Haijing, AV Display, Truly Semiconductor |
|---|---|---|---|
| 6. | Communication Module Interface | Communication module interface should be compatible for the two RS-485 ports (One for Optical port for communication with meter reading instruments & the other port for the RS232 port to communicate with various modems) | National Semiconductors, ST, Hitachi, Texas Instruments, Philips, HP, Agilent, Everlight, Fibocom, Fairchild, Exar, Osram, Avago-Tech, Liteon |
| 7. | Optical Port | Optical port should be used to transfer the meter data to meter reading instrument like Laptop/HHU/CMRI etc,. The mechanical construction of the port should be such to facilitate the data transfer easily. | As specified |
| 8. | Communication Modem Module | The modem shall support both 4G (fallback to 3G and GPRS) mode of communication and shall be inbuilt module which should be Plug-in type (Modular Type) to modular communication slot inside Meter | Qualcomm, Samsung, Motorolla, Sony Ericsson, Quectel,Gemalto, Telit, Cinterion, Sierra, Neoway,ASR |
| 9. | Connection / Disconnection Relay | The relay to connect and disconnect supply to load from Meter shall be of very high quality. | KG Technologies, Omron ISTEK, Honeywell, Hongfa, Gruner, Johnson Electric, |

| 10. | Power Supply | The power supply should be with the capabilities as per the relevant standards. The power supply unit of the meter should not be affected incase the maximum voltage of the system appears to the terminals due to faults or due to wrong connections. | As Specified. |
|-----|--------------|------------------------------------------------------------------------------------------------------------------|---------------|
| 11. | Electronic Components | The active & passive components should be of the surface mount type & are to be handled & soldered by the state of art assembly processes. | Philips, Toshiba, Panasonic, Fairchild, Analog devices, ST, Maxim, Honeywell, Murata, Rohm, Siemens. National semiconductors, ATMEL, Texas Instruments, Hitachi. OKI, Toshiba, Epson, Kemet, Alps, Muruta, TDK, Sanyo, Samsung, Epcos, Diotech, Kemet, Yageo, Everlight |
| 12. | Mechanical Parts | The internal electrical components should be of electrolytic copper & should be protected from corrosion, rust etc. The other mechanical components should be protected from rust, corrosion etc. by suitable plating/painting methods. | As Standard. |
| 13. | Battery (Internal & External Batteries) | Only non-rechargeable battery like Lithium / Lithium-ion / Ni-MH with guaranteed life of 10 years shall be used for RTC as well as display in absence of power, the battery shall be backup by an exchangeable battery. | Renata, Panasonic, Varta, Tedrium, Sanyo, National, Teridian, Duracell, Maxell, Tekcell, Elegance, EVE, Mitsubishi, SONY, Casio |
| 14. | RTC/Micro-Controller | The accuracy of RTC shall be as per relevant IEC standards. | Philips, Dallas, Atmel, Motorola, NEC, Renesas, Hitachi, Xicor, Texas Instruments, Renergy, NEC, OKI, ST Mitsubishi |

# SCHEDULE OF GUARANTEED TECHNICAL PARTICULAR
## (TECHNICAL DATA SHEET)
(To be filled in by the Bidder/ Manufacturer)

The Bidders/manufacturers are required to furnish the following information in the Data Sheet. Separate sheets can be used if additional space is required. The information furnished shall be supported by the catalogue and test reports. The information not supported by the catalogues, test reports etc. shall be deemed to have been "Not Provided". The bidders/manufacturers are also required to underline the information asked for in the catalogue and /or test reports. Any deviation from NEA's requirements shall be clearly mentioned giving the reasons thereof.

| S.No | Description | Unit | NEA's Requirements | Bidders Offer for Single/Three Phase DC /CT Operated |
|---|---|---|---|---|
| 1 | Name of Manufacturer and Country of Origin | | Single/Three Phase DC/ CT Operated | |
| 2 | Type and Catalogue number/Model number | | | |
| 3 | Accuracy Class | - | Class 1.0/1.0/0.1 for Active Energy (kWh) or better | |
| 4 | Applicable Standard | - | As per Specification clause 2 | |
| 5 | Meter Type & Certifications | - | As per Specification clause 3 | |
| 6 | Data Display Facility & Profile Parameters | - | As per Specification clause 4 & 4.1 | |
| 7 | Auxiliary Power Consumption | - | As per Specification clause 5 | |
| 8 | Accuracy Requirements | - | As per Specification clause 6 | |
| 9 | Active Energy | - | As per Specification clause 7 | |
| 10 | Maximum Power | - | As per Specification clause 8 | |
| 11 | Current Active Power | - | As per Specification clause 9 | |
| 12 | Voltage Metering (Electricity metering Quality) | - | As per Specification clause 10 | |
| 13 | Maximum and Minimum Voltage | - | As per Specification clause 11 | |
| 14 | Voltage Variation | - | As per Specification clause 12 | |
| 15 | Under and Over Voltage | - | As per Specification | |

| | | | clause 13 | |
|---|---|---|---|---|
| 16 | Current Metering | - | As per Specification clause 14 | |
| 17 | Phase Presence | | As per Specification clause 15 | |
| 18 | Time and Date | | As per Specification clause 16 | |
| 19 | Battery Backup as Redundant Power Source | | As per Specification clause 17 | |
| 20 | Display Power up in Absence of Mains Supply | | As per Specification clause 18 | |
| 21 | Additional Power supply (Internal and External Batteries) | | As per Specification clause 19 | |
| 22 | Display | | As per Specification clause 20 | |
| 23 | Keys | | As per Specification clause 21 | |
| 24 | Number of Tariff | | As per Specification clause 22 | |
| 25 | Impulse | | As per Specification clause 23 | |
| 26 | Climatic Conditions | | As per Specification clause 25 | |
| 27 | Mechanical and Constructional Requirements | | As per Specification clause 26 | |
| 28 | Meter's Communication & CMRI /HHU Device with Meter Reading Software | | As per Specification clause 28 | |
| 29 | Anti-Tampering Features | | As per Specification clause 29 | |
| 30 | Disconnection and Reconnection Mechanism | | As per Specification clause 30 | |
| 31 | Switching / Relay Element Details | | As per Specification clause 31 | |
| 32 | Time & Date | | As per Specification clause 32 | |
| 33 | Data Communication Module and related Features | | As per Specification clause 33, 33.1, 33.2, 33.3 and 33.4 | |
| 34 | Battery Life | | As per Specification | |

| | | | clause 34 | |
|---|---|---|---|---|
| 35 | Connection Diagrams, Phase Sequence and Terminal Marking | | As per Specification clause 35 | |
| 36 | Guarantee | | As per Specification clause 36 | |
| 37 | Type Tests | | As per Specification clause 37 | |
| 38 | HHU or CMRI Device & Optical Probe Cable with required Microsoft Windows or Android/IOS OS with specifically designed and developed software to read/download meter data from proposed meters using Optical Probe and then upload to AMI/HES/MDMS Server via its' own GPRS/3G/4G modem in the event when GPRS connectivity is not available at meter site should be provided as mentioned in Clause 28. | Yes/ No | Yes | |
| 39 | Whether the Meter is capable to communicate directly to Laptop/CMRI/HHU | Yes/ No | Yes | |
| 40 | Whether all costs related to design, development, supply and implementation of Head End System (HES), MDMS, Base Computer Software (BCS) & Mobile Application (Mobile APP) Software for Meter Programming, Replacement & Installation Works as mentioned in Clause 38 are already included in the offer? | Yes/ No | Yes | |
| 41 | Whether all costs related Training to NEA Staff for Operation & Handling of overall System as mentioned in Clause 39 are already included in the offer. | Yes/ No | Yes | |
| 42 | Meter provided with Plug-in type Modular Slot with RF/GPRS/PLC Modem Module with Data Communication Modem Module & Features as mentioned in Clause 33 provided? | Yes/ No | Yes | |

| | | | | |
|---|---|---|---|---|
| 43 | The Rated Shelf Life of Battery | Years | Min. 15 Years | |
| 44 | Whether the Meter has Capability to Check the Correctness of Connections at Site? | Yes/ No | Yes | |
| 45 | Meter designed and manufactured by using make of Component as per given "List of Components Make for Smart Energy Meter" | Yes/ No | Yes | |
| 46 | Type Test Report Carried out within 5 Years from the date of opening of tender from the testing laboratories Specified in Clause 37 submitted? | Yes/ No | Yes | |
| 47 | Whether Sample Meter manufactured using all components as mentioned in "List of Components Make for Smart Energy Meter" and as per tender specification and complying all Tests as mentioned in Clause 47 is submitted? | Yes/ No | Yes | |

We certify that the above data are true and correct

…………………………………………………...
(Seal and Signature of the Bidder / Manufacturer)

**TECHNICAL SPECIFICATION FOR PILFER PROOF METER BOX SUITABLE FOR SMART ENERGY METER**

**Scope**:
This specification covers design, manufacture and supply of Pilfer Proof Molded Meter Box suitable for Single Phase Smart Energy Meters. The meter box shall be suitable for wall and pole mounted type installation.

**Technical Requirement and Standard:**
The meter box shall be made out of hot-pressed molded, unbreakable, high grade, fire retardant, with base of meter box non-transparent and cover transparent Polycarbonate + Glass Fiber with flame retardant properties having good dielectric & mechanical strength. The material must be U.V. stabilized to ensure that the Meter Box should not change in color, shape, size, dimension when subjected to U.V. Ageing Test. The Meter Box should have top tapered surface/round corners to prevent stay of rain water at the top of the Meter Box.

The Meter Box shall be capable of withstanding the mechanical, electrical and thermal stress as well as the effects of humidity which are likely to be encountered in service. At the same time, the same should ensure the desired degree of safety. The plastic material used should be adequately stabilized against detrimental effect of light and weather. The surface appearance of the molded parts must be smooth, non-porous and homogeneous, free of ripples, defects and marks. No fillers of fibers should be visible at any place. The Box shall comply in all respect with the requirement of latest Amendments of IEC. Applicable degree of protection shall be IP-54.

The Enclosures shall generally comply with the provision of IEC-695. The enclosures shall be suitable for outdoor application. The enclosure shall be with good workmanship. Soft neoprene/nitrile rubber gaskets should be provided all rounds wherever required for protection against entry of dust and water. The enclosure shall comply with IP-54 degree of protection.

**General Constructional Requirement:**
The width, height and depth of meter box shall be suitable and designed to adequately fit the Single -Phase Smart Energy Meters with all the accessories with ample space all the sides for easy installation and removal of meter. Thickness of the enclosure shall not be less than 2.5 mm on all sides including door. The enclosure shall have at least 4.0 mm thickness of the tongue and groove area.

There should be a minimum 30mm (single Phase), 50mm (Three Phase) clearance on all sides from the meter surface (projected) except the bottom side which should be minimum 80mm (Single Phase) 200mm (Three Phase)from the lower edge of terminal block. Also, the meter mountings inside the meter box will be such that the meter base support inside box should be preferably raised by about 10+/-2mm for each item for each of working.

**Viewing Window:**
A Viewing window made up of scratch and break resistant, UV resistant, transparent Polycarbonate shall be provided on the door for reading the meter without inconvenience. There shall not be any ingress of moisture through this window in to the meter box.

The meter box should have provision for meter reading using Optical Probe through CMRI/HHU device on the cover of meter box without opening the meter box cover along with separate sealing arrangement.

**Hinges:**
The axes of the door provided on the body and cover of the enclosure in such a manner that the door opens by a minimum of 120 degrees.

**Locking Arrangement:**
The cover should be fitted with base and should be of axes. The covers are to be fixed on the base of meter box in such a way that any access from outside is not possible. The meter box must have 2 individual seals to make it fully tamper proof.
Arrangement for Inlet & Outlet Cable Entry:
Two (2) nos. circular holes having at least 25mm or bigger diameter to support Copper or Armored Aluminum Input Cable of 20 sq. mm shall be provided at the bottom of the Meter Box for inlet and outlet cables.

**Base and Cover Details:**
The cover shall be made overlapping type having collars on all 4 (four) sides. The cover of the meter box shall be provided with Gasket of sufficient size to completely fit in the grooves of the base. The gasket should be made of high-quality rubber. The base of the meter box must have a groove to hold the Gasket and the overlap of the top cover with base must be minimum 6mm.

There should be provision to write Consumer Name, Consumer No, Approved Load etc., at bottom area of Meter Box Cover by Utility Officials after meter and meter box installation.

**Fixing Arrangement of Meter Box:**
For fixing the meter box to wall or wooden board, 4 nos. holes of minimum 4mm diameter shall be provided at the four corners of meter box. The meter is to be installed in the meter box and the meter box in assembled condition shall have provision to fix it on wall or pole. The 4 nos. self-threaded screws of minimum size of 4mm diameter and 25mm long shall be provided with each meter box.

**Marking/ Embossing:**
The following information shall be clearly & indelibly embossed (or permanently printed) on the cover and base of the meter box. The top & bottom corner of meter box serial number shall be same for the particular meter box.
i)   Supplied by NEA
ii)  Name/Brand Name of Manufacturer
iii) Meter Box Serial Nos. (Embossed on both the base & covers of Meter Box)
iv)  Sign of Danger

**Drawing:**

Detailed dimensional drawing showing clearly dimensions & material for Meter Box and its' constructional features shall be furnished by the bidder along with the bid.

**Submission of Sample:**
The bidder shall submit a sample meter box as per our specification (or, as available with bidder, however in the event of order it will be as per Specification before first inspection) along with the sample meter to the office on or before last date and time of submission of bid. Submission of sample meter box as per size available with the bidder but conforming to our specification towards its' quality is acceptable. Type testing of one-meter box manufactured as per specification is to be conducted at any ILAC/IAF accredited laboratory by the supplier at their own cost after placement of order. For type testing the meter box will be selected from the first offered lot of meter box. If the type test results are not found satisfactory, the offered lot meter box will be rejected.

**Guarantee:**
The meter box should be guaranteed against any manufacturing defects arising out of faulty design or bad workmanship or component failure for a period of 5½ years from the date of supply.

The meter box found defective within the above guarantee period shall be replaced by the Supplier free of cost within one month of the receipt of intimation of failure/defect. Defective meter box are to be replaced by new one with new sl.nos.as allotted by NEA.

**Replacement of Defective Meter Box:**
The meter box declared defective by the NEA shall be replaced by the supplier upto the full satisfaction of the NEA at the cost of supplier within 60 (sixty) days from the date of intimation by the purchaser. Failure to do so within the time limit prescribe shall lead to imposition of penalty of twice the cost of meter box. The same may lead to blacklisting even, as decided by NEA. In this connection the decision of NEA shall be final.

**Inspection**:
The inspection will be carried out as per inspection & testing clause of General Conditions of Contract (GCC).

**Testing**:
The bidder must furnish type test report including material verification of the offered/sample meter box from any ILAC/IAF approved laboratory as available with them along with technical bid without which the offer will not be considered. Type test report should not be more than 5 (five) years old.

The acceptance test shall be carried out at the time of inspection of the offered material. Routine test certificates/reports shall be submitted to the purchaser's inspection office at the time of inspection shall be carried out at the time of inspection of the offered material.

Sample selected from first lot should be tested at ILAC/IAF accredited third party independent test house for compliance of performance parameters as per relevant IEC 60529 standards.
The test report should be submitted to NEA before completion of order.
Inspection of each lot, sampling plans for test: 1 nos. selected randomly from lot for testing at works.

| S. No. | Test Requirement for molded meter box | Reference Standards |
|---|---|---|
| (a) | Marking | IEC |
| (b) | Dimensions & Construction | IEC |
| (c) | Heat Deflection Temperature (Min.135°C) | IEC |
| (d) | Spirit Burner Test (Self Extinguishing) | IEC |

**Specification of RF (Radio Frequency) Communication Module for Meter and Data Concentrator Unit (DCU) to form RF Mesh Network**

The RF communication module shall be designed to work on frequency range of 396.5MHz~399.5MHz among group of Smart Meters and Data Concentrator Unit (DCU), Repeaters, access Points etc., for extremely robust communication based on reliable and highly secured connections. It shall be applied frontal of smart meter slot. It shall be mainly used for meter to provide electricity information collection to HES system via DCU or Gateway.
The communication system of RF module shall be high-reliability, anti-interference, and self-healing communication and adaptive mesh network.
The RF communication technology shall follow open standards that shall be interconnected by multiple manufacturers, the RF module shall support IEEE802.15.4 Standards and WiSUN FAN protocol.
The RF communication module shall be self-adapting mesh network, support auto-registration to join the network and IPv6.
The RF communication module support Frequency Hopping Spread Spectrum (FHSS) and handle 10 hops from root of the mesh tree.
The RF communication module support flexible networking organization
The RF communication module shall support 50kbps/ 150kbps/ 300kbps.
The RF communication module support security features, include AES128, PKI authentication and authorization and key management.
The RF communication system shall support at least 10 depth of router, the communication distance of each level must be at least 150~300 meters supporting at least 1000 nodes/meters.
The RF communication module shall support the power outage alarm function so that when the meter becomes power-off, it shall automatically report a power outage event to HES.
The RF communication module shall Support dynamic routing mechanism, automatic repair of failed communication path.

The RF communication system Data link layer shall support data re-transmission mechanism with three modes: unicast, local broadcast, and network-wide broadcast.

The RF communication module shall be a Plug-in communication module which shall be used for Data Concentrator Units (DCU) and Smart Meters and shall be used at x/0.4 kV low voltage network.

The RF communication module must have its' own reliable microcontroller (MCU) used as the main chip, designed for extremely robust communication based on reliable and highly secured connections between devices.

The RF communication module must be designed and built to be resistant to overvoltage as well as incorrect meter connection to the network, to the same extent to which the meter is resistant to other potentially disrupting causes (such as atmospheric discharge, irregular connection, neutral conductor disconnection, one or two phases disconnection etc.). During disrupted network conditions, module functioning shall not be conditioned.

The RF communication module must have its' power supplied from the meter.

The communication distance between meters and data concentrator shall cover 300m to 1000m via re-transmission. The communication distance between two nearest meters shall be up to 300m.

When the new meters are installed, the meter number shall be read via RF communication module and be sent to the DCU/HES automatically.

The events alarm produced by smart meters shall be sent to the DCU/HES automatically through the RF communication.

The RF communication module shall enable Self-organized networking and realize the networking automatically. No manpower shall be needed for setting-up the parameters on site.

The data relay/route transmission between meters and gateways/data concentrators shall be realized by RF communication module automatically. Every RF communication module shall realize the data relay/route retransmission, no manpower shall be needed.

The RF module must be equipped with the watchdog for execution of RF module hardware reset. If the module remain inactive for an extended period of time (time shall be set as parameter), all communication parameters located in the module at the moment of reset must be saved.

The RF module shall support power outage report or last gasp alarm.

The RF communication at application level must be compliant with the DLMS/COSEM specification.

The RF module shall support firmware update via HES.

## Data Concentrator Unit (DCU)

The Data Concentrator Unit (DCU) shall be a communication device to collect data from various collection terminals or smart meters, processes and stores them and can exchange data with the HES or CMRI/HHU handheld devices at the same time. The DCU shall have design architecture based on Linux Operating System and integrates GPRS/4G module, Ethernet adapter and RF/PLC module with following features;

The DCU shall collect the real-time electric energy indication value, daily frozen electric energy indication value, and monthly frozen electric energy indication value of each electric energy meter

The DCU shall have Wi-Fi port to be used for local maintenance, data reading, parameter setting and reading.

The DCU shall have 2 x Ethernet ports, one shall be used for communication with HES, and the other shall be used for local maintenance.

The DCU shall support metering function to get the measurement data of distribution transformer such as energy, harmonic and load profile, and monitor its working status such as overload, unbalance or over voltage etc.

**Functional requirements of DCU**

| S. No. | Item | Requisites | Comments |
|---|---|---|---|
| 01 | Data Processing | Must collect, process, and store meter data, and upload the data to the HES as needed/required for the HES to do power analysis and power management. | |
| 02 | Data Collection | Must provide collection of real-time data, historical data, event data, and status data. The data collection process complies with IEC 62056 (DLMS/COSEM). | |
| 03 | Data Storage | Must provide cyclic storage for minor and major events and historical data, including the load curve, hour frozen data, daily frozen data, and monthly frozen data. | |
| 04 | Random Collection | Must collect specified meters' relevant data directly according to HES system's command by HES system repeating meter reading method. With this method, the DCU must receive HES system's command and transmits it directly to the meter, waits for the meter to return the data and then transmits meter's response data to HES system. During this period, DCU shall not make any processing to the command. | |
| 05 | Scheduled Reading | Must automatically collect meters' data (such as daily data, monthly data, load profile etc) according to the configured meter reading scheme, and automatically transmits the data to HES system in the form of a task. The task can be flexibly configure the data items required for the collection, and can set the collection time and transmission time interval in accordance with the task. | |
| 06 | Event record and ALARM | Power up<br>Power down<br>Firmware activated<br>Module firmware activated<br>Clear data | |

| S. No. | Item | Requisites | Comments |
|---|---|---|---|
| | | Clock adjusted (new date/time) <br> Communication abnormal of module <br> Communication restored of module <br> Module cover removed <br> Module cover closed <br> Standard events <br> Fraud events <br> Relay events <br> Power grid events | |
| 07 | Synchronization | Must support time synchronization both locally and remotely. | |
| 08 | Metering Function | With metering function, it shall be used as a reference metering equipment for the transformer load. （Not used for billing） <br> Active energy: Class 0.5s <br> Reactive energy: Class 2 | |
| 09 | Firmware Upgrade | Remote and local firmware upgrade <br> Meter firmware remote upgrade. <br> DCU (Data Concentrator Unit) firmware remote upgrade. <br> RF Module firmware remote upgrade. | |
| 10 | Remote Configuration | RTC calling and synchronization <br> DCU parameter setting and query <br> Web parameter configuration <br> Meter parameter query | |
| 11 | Web Service Management | Must have Web service management | |
| 12 | Automatic Meter Detection | Must have Automatic table search function, can detect new table and register to the concentrator | |
| 13 | Large Capacity NVM | Must have at least 256MB Flash Memory, shall be able to store daily freezing and curve data of 1024 set Smart energy meters | |
| 14 | Simultaneous Meter Reading | The RF module must support simultaneous meter reading which sends multiple meter reading frames at the same time, the meter reading rate per unit time and the magnitude of data items are greatly improved | |
| 15 | Network Communication | Communication with meter (Down-Link); RF/GPRS/3G/4G <br> Communication with HES (Up-Link); GPRS/3G/4G <br> Local Communication : RS232/Wi- | |

| S. No. | Item | Requisites | Comments |
|--------|------|-----------|----------|
| | | Fi/USB2.0/RS485 | |
| 16 | Plug and Play Communication Modules | RF/GPRS Module must support Plug and Play communication modules | |
| 17 | Back-up Power | Super Capacitor/ Battery (optional)<br>Super capacitor must support last gasp to system and guaranteed that the system shall not be abnormal in case of sudden power failure<br>Battery: 1500 mAH lithium rechargeable battery that support 2 hours GPRS communication when power outage | |
| 18 | Easy & Friendly UI | LCD/LED display | |
| 19 | Man-Machine Communication | Buttons/LCD for View parameters and data reading.<br>USB for upgrade procedures, log storage and export.<br>RS-485 for view and set parameters upgrade procedures and data reading.<br>Wi-Fi/RS-485 for web service that shall use smart phone to view and set parameters and data reading. | |
| 20 | Local Wireless Maintenance | RF Module for local wireless maintenance:<br>Data reading<br>Parameter setting and reading<br>Equipment operation log monitoring | |

Technical Specification of DCU

| S. No. | Description | Unit | Minimum Requirements REQUIRED | Minimum Requirements TENDERED |
|--------|-------------|------|-------------------------------|-------------------------------|
| 01 | Manufacturer's Name | - | | |
| 02 | Country of origin | - | | |
| 03 | Model Number/ type | - | | |
| 04 | Display | - | LCD/LED display | |
| 06 | Weight | kg | ≤ 2.0 kg | |
| 07 | CPU Processor | - | 32 bit Processor | |
| 08 | Operating System | - | Linux | |
| 09 | Internal | - | IPv4 | |

| S. No. | Description | Unit | Minimum Requirements REQUIRED | Minimum Requirements TENDERED |
|---|---|---|---|---|
| | Protocol | | | |
| 10 | Flash Memory | MB | 256 MB | |
| 11 | RAM | MB | 64MB DDR2 | |
| 12 | Firmware | - | Upgradable | |
| 13 | Maximum Power | W/ VA | $\leq 15$ W, $\leq 20$VA | |
| 14 | Connection Wiring | - | 3-Phase | |
| 15 | Power Supply | V | AC:90~290V power supply, support three-phase four-wire and single-phase power supply | |
| 16 | Current Range | A | Ib /Iref:1A<br>Imax: 10A | |
| 17 | Metering Accuracy | - | Active energy: Class 0.5s<br>Reactive energy: Class 2 | |
| 19 | Frequency | Hz | 50Hz $\pm$ 5% | |
| 20 | Insulation Protection | - | Class II | |
| 22 | Dimensions (HxWxD) | mm | 300mmx 175mmx 78.3mm (L x W x H) | |
| 24 | MTBF | Hour | $\geq$ 50,000 hours | |
| 25 | Up-link | - | GPRS/3G/4G | |
| 27 | Up-Link Protocol | - | IEC 62056 (DLMS/COSEM) | |
| 28 | Down- link | - | RF | |
| 29 | Down-Link Protocol | - | IEC 62056 (DLMS/COSEM) | |
| 30 | Maximum Connected Meters | - | 500 | |
| 31 | Ingress Protection Level | - | Must be IP54 (With Sealed Box) | |
| 32 | Security | - | Support AES 128/AES 256 | |
| 33 | Remote Upgrade | - | Support OTA (Firmware Over the Air, FOTA) technology | |
| 34 | Last Gasp | - | When power off, the concentrator will send the alarm to Master Station. | |
| 35 | Battery | V | 4.8-6.0 V DC | |
| 36 | RTC Battery Life Time | Years | 15 Years | |

| S. No. | Description | Unit | Minimum Requirements REQUIRED | Minimum Requirements TENDERED |
|---|---|---|---|---|
| 37 | DCU Life Time | Years | 15 Years | |
| 38 | Real Time Clock Accuracy | s/day | ±0.5 s/day at ±23 Centigrade | |
| 39 | Instant Maintenance | - | USB port for upgrade firmware RS232/RS485and Wi-Fi port for field maintenance | |
| 40 | Operating Temperature: | °C | -40°C to +70°C | |
| 41 | Storage Temperature: - | °C | 45°C to +85°C | |
| 42 | Relative Humidity: | - | < 95% | |
| 43 | Ingress Protection | - | Must be IP54 (With Sealed Box) | |
| 44 | Plug and Play Communication Module | - | RF Module/GPRS Module Module | |
| 45 | Insulating Strength | kV | Impulse Voltage: 1.2/ 50μs main connections 6 kV AC voltage: 4kV during 1 min | |
| 46 | EMC | kV | Electrostatic discharge: Contact discharge: 8kV/ Air discharge:15kV Fast transient burst: 4 kV Surge immunity: 4 kV | |

**Technical Specification of Repeater**

**Self-organized Networking:** It must support RF Specification that realizes the networking automatically. No manpower shall be required for setting-up the parameters on site.

**Single Phase or Three Phase Signal Relay:** When it works normally, one phase and neutral line must remain power on. It must support single-phase relay as well as three-phase relay.

**Automatic Relay of the Carrier Signal:** The data relay transmission between meters and gateways/data concentrators must be realized by RF communication module automatically. It must realize the data relay retransmission; no manpower is needed.
Ability to Signal Relay: The minimum signal relay depth of repeater must be 7th Node level.

# Head End System (HES), Base Computer Software (BCS), Mobile Application (Mobile APP) Software and Enhancement of existing Meter Data Management System (MDMS) Software Works:

- The bidder is fully responsible to design, develop and implement Fully Web-based Head End System (HES) as per Hierarchy of NEA with NEA Data Models (Generic Profile Parameters) as mentioned in RFP (Bid document) and integrate same further to Core Billing & Revenue Management System (CRMS) Software of NEA on their own resources and without any extra cost to NEA. All costs of study, analysis, design, development, integration and operational training must be already included by bidder.
- The software shall have Multi-Level Authentication (2 Factors/OTP based) mechanism for Login and Multi-level approval mechanism (OTP) based on Hierarchy of NEA for various functions like Approved Demand Change, Parameter Writing, Relay Connection & Disconnection, Event & Tamper Clear etc. where User initiates request and Supervisor or Manager needs to approve the request for execution of requested command to program/write in Smart Meter.
- The software shall be Fully Integrated with existing Core Billing & Revenue Management System (CRMS) Software running in various Branch Offices (Distribution Centers) for automatic Monthly Consumption Bill generation and sending to Consumers via Email and SMS.
- The software shall have associated Integrated Mobile Applications (Mobile APP) with details Reports to do Automated Electro-Mechanical to Smart Meter Replacement (EM2SM) Works, New Smart Meter Installation (SM Installation) Works for New Service Connection, Smart Meter to Smart Meter Replacement (SM2SM) Works, Modem Replacement, Meter Status Check with provision to capture & cross-verify meter serial number via Bar Code scanning, Meters Picture Capture, GIS-Latitude & Longitude, other Consumer related information with Mobile Number and Email Address during Meter Replacement/Installation Works.
- The software shall have independent User Management System Mobile Application which will be used for Meter Replacement or Installation Works based on Hierarchy of NEA.
- The software & Mobile Application shall capture and store GIS Data (Longitude & Latitude) for all Smart Meters which can be plotted in GIS Map as and when needed.
- The software shall have Common Dashboard with Reports (as per Hierarchy of NEA) to show following details;
  - Number of Total Meters Configured
  - Number of Total Communicating Meters
  - Number of Non-Communicating Meters
  - Number of EM-2-SM Replacement
  - Number of New SM Installed
  - Number of SM-2-SM Replacement
  - Number of Total Not-Configured Meters
  - Total Not-Configured Meter without Consumer Master Data
  - Total Number of Un-Subscribed Meters

- Total Number of Not-Programmed Meters
- Number of Total Consumption Bill (via Email & SMS)
- Number of Tamper Events Occurred

- The software shall have various reports for Billed Data to show whether any Consumer has been billed exactly as per Billing Software or not on Billing Date/Day, Billing Tool Status to monitor Billing Tools operation in Branch Server, Billing Status & Billing Log Reports for Never Communicating Meters, Never RAW Received Meters, Never Alarm Received Meters, Never Instant Data Received, Date Time Difference with HES.
- The software shall have provision to enter Consumer Monthly Billing Data (taken via SMS or site meter reading) directly to prepare and send Monthly Consumption Bill.
- The software shall have provision for downloading Meter Data and Billing Data from any Meter using Optical Probe Cable using CMRI (Common Meter Reading Instrument) / Hand Held Unit (HHU) and then upload to Head-End-System (HES) via GPRS/3G/4G/Wi-Fi with Detail Report. This will be very useful manual meter reading works in such locations where GPRS/4G signal is very weak or temporarily not available for some days/weeks.
- The software shall have Email and SMS System with Dashboard and Report to send Monthly Consumption Bill & Information to Consumer via SMS and Email.
- The software shall have Email and SMS System with Dashboard and Report to send Information related to Events & Alert related Tamper Events Information, Alert of Approved Demand Change, Contracted Demand (Approved Demand Violation, Cancellation of Subscription via SMS and Email to Designated Official of NEA as defined in Hierarchy.
- The software shall provide report & alert for Approved Demand (Contracted demand-KVA) Mismatch cases by Cross-Checking and Comparing Approved Demand programmed in Meter with approved demand mentioned in Billing Software of NEA.
- The software shall have following Standard Reports;
  - Consumption Reports
  - Contracted Demand/Approved Demand Violation Report
  - Any Phase Voltage or Current Missing Report
  - Voltage or Phase Unbalance Report if Applicable
  - Approved Demand Update Report
  - Meter Firmware Update Report
  - Modem Firmware Update Report
  - Meter Configuration (CFG) File Update Report
  - Relay Disconnection & Reconnection Report
  - Unbilled Consumer on Billing Date Report
  - Tampers Summary Report
- The software shall have provision for Scheduled as well as On-demand Meter Reading function to download Instantaneous, Load Profile and Billing Parameters of Individual or Group of Meters.
- The software shall have provision for On-demand Configuration Parameters reading and writing with approval from concerned Admin User or Branch Manager.

- The software shall have provision for On-demand Polling / Fetching of Relay Status in Meter. The Disconnection & reconnection of Relay initiated by any Operator shall be executed only after approval from concerned Admin User or Branch Manager.
- The software shall have provision for Automatic Alert Mechanism for Serious Tamper Events to concerned Officials via email or SMS.
- The software shall have provision for Firmware Upgrade function for Meter, Modem over GPRS, Configuration (CFG) File writing on Single or Group of meters with approval from concerned Admin User or Branch Manager.
- The software shall have provision for Single Meter View to generate reports of any Consumer/Meter Information for Instantaneous, Load Profile, Billing Profile, Events Profile Parameters, etc.
- The software shall have provision for Single or Bulk Uploading of Consumer Master retrieved from Billing Software for Field Meter Replacement/Installation Works.
- The software shall have provision to display all Smart Meters in GIS Map as per Location Hierarchy of NEA in Nepal with basic information related to Consumer & Meter like; Meter Number, Meter Status, SIM/MDN No, Consumer Name, Consumer No, Approved Demand, Total Consumption in KWH, Associated Branch Name etc., wherever as possible.
- The software shall have provision to carry-out replacement of existing Electro-Mechanical Meters to Smart Meter, replacement of any defective or burnt smart meter with new smart meter and Cancellation of already registered smart meter allotted to any Consumer with History Log Report of their previous Consumption and other details.
- Non-Communicating Meter report shall be available to enable the concerned branch office to get the meter reading in alternate modes or rectify the communication issue.
- The system shall be in a position to cater to changes in the metering cycle. Metering in certain cases maybe TOD, hourly, daily, fortnightly etc.
- Dash board shall reflect Total Number of Meters read out of total configured Meters along with details of mode of Meter reading like automatically or manually through HHU/Laptop/CMRI.
- The Software and overall data communication system must support IPv4, IPv6 and protocols.
- The HES shall support automatic meter registration mode and can read network topology.
- The HES shall monitor meter's status, such as meter online/offline status, online rate, signal intensity etc.
- The bidder shall design, develop and integration Mobile Application (Mobile APP) to execute automated Meter Installation & Replacement Works at Consumer Locations wherever 4G/3G/GPRS data service available to provide facilities for *a.) New Smart Meter Installation for New Consumer b.) Meter Replacement from existing Electro-Mechanical Meter to Smart Meter c.) Smart Meter to Smart Meter Replacement d.) Modem Replacement e.) Status Checking of any Meter* etc.,

  The Mobile APP shall work on any Android/IOS based HHU/Mobile Phone in ONLINE mode over internet after authorized login with proposed Web-based Head End System (HES). The Mobile APP shall automatically synchronize/download latest Consumer Master Details from proposed Web-based Head End System (HES) after login. The Mobile APP shall provide facility to capture and send details like Provincial Office

Name, Branch Name, Sub-Branch Name, Consumer Name, Consumer No, Consumer ID, Approved Demand, Make/Serial No/Picture/Current Consumed Unit of existing Electro-mechanical Meter, Make/Serial No/Picture of New Smart Meter, GIS Coordinate (Longitude & Latitude) of Meter Location, SIM MDN Dialing Number, Consumer Mobile Number & Email Address, Installer Name, NEA Official Name etc, via web services. The HES Software shall provide detail Field Installation/ Replacement Report based on Location Hierarchy of NEA for any day or date range. The Mobile APP must be able to display Basic Electrical Parameters related to any Meter/Consumer in separate interface.

- The bidder shall design, develop and provide Mobile Application (Mobile APP) to use as Base Computer Software (BCS) at meter locations wherever GPRS data service not available or very weak to provide facilities for programming/writing & reading various Consumer related parameters in OFFLINE Mode using Optical Probe Cable. The Mobile APP shall work on any Android/IOS OS based HHU/Mobile Phone with local authentication mechanism for defined time period to provide role as Operator or Supervisor or Administrator. The Offline Mobile APP shall facilitate to update Firmware for Meter and Modem, writing Configuration (CFG) File, Reading Meter Information, writing basic parameters related to Consumer like Consumer ID, Consumer No, Consumer Name, Approved Demand, Billing Date, TOD Tariffs, Reading Relay Status & Events, and Clearing Tamper Events during Meter Installation Works etc.

- The bidder shall design, develop and provide Mobile Application (Mobile APP) to use by Meter Readers in various Branch Offices of NEA to download Meter Data, Billing Data from any Smart Meter wherever GPRS internet service is not present using Optical Probe Cable and then further upload to HES Software via GPRS or Wi-Fi internet connectivity.

- The bidder shall design, develop and provide Base Computer Software (BCS) to program or read/write operation of various parameters/settings related to Meter, Consumer, Generic Profiles, Monthly Billing Profile, Local & Remote Communication, Main & Auxiliary Relay Control, PUSH Action for Parameters, Active & Passive Tariffs, Prepayment Mode/Postpaid Mode Operation, Firmware Upgrade, Events & Status Words as well as Various Configuration/Parameters Settings related Demand, Instantaneous, Power Quality, Generic Profile, Billing Profile, Events, Display objects  etc,. The BCS shall work only after registration with valid registration code. It shall provide read only operation for Operator role and read & write operation for Administrator role after authentication. The BCS must have System Log interface to show complete log and executed commands with respective DLMS data content.

## Enhancement of existing Meter Data Management System (MDMS) Software of NEA;

### General Overview;

The existing Meter Data Management (MDM) System Software of NEA supports storage, archiving, retrieval & analysis of meter data and various other MIS along with validation & verification algorithms with Oracle Database. NEA intends to further enhance its' existing MDM Software to ensure following features;

- It shall act as a central data repository with interactive dashboard. MDM shall have capability to import raw or validated data in defined formats and export the processed and validated data to various other systems sources and services in the agreed format. It shall provide validated data for upstream systems such as billing, analytics, reporting, etc.
- MDM should also support the future requirement of NEA and should support the integration of other smart grid functionalities like consumer Information System, Customer Care, Network planning & analysis, load analysis/forecasting, Peak Load Management, Outage management, Distribution Transformer Health Monitoring system, self-healing system etc. as and when implemented by NEA.
- The contractor shall specify and deliver an initial system that supports the collection and storage of data for meeting the performance level for optimal number of smart meters with facility of future expansion as mentioned in this document.
- The MDMS shall have the ability to selectively choose which data to be maintained and which to be purged or archived as per requirement of utility (user selectable).
- The MDMS shall maintain information and relationships between the current installed meter location (Residential, Business, Industry, Education, Irrigation, Commercial, Hospital, Shop, industry / address etc.), Consumer information (Name etc.), Consumer account no, Meter ID, Type of Meter (type of consumer, 1 phase/3phase, with or without relay, etc.), Meter configuration (Demand integration period, Load profile capture period etc.), GIS supplied information (longitude, latitude, connection with feeder/ transformer/ pole etc.) etc.
- The MDMS software shall support tracking the status of meters and communication equipment from the date when they are installed in the field. The history of in-service asset location should be maintained through-out the device life with start and end dates associated with each in-service location reference.
- The MDMS should support device lifecycle management from device registration, installation, provisioning, operations and maintenance, replacement to decommissioning (lagat-kharaj) etc. The MDMS shall generate exceptions for meter or modules not delivering the correct meter data after installation.
- The MDMS shall provide a reconciliation report that identifies the meters that have been installed but not communicating for a designated (configurable) period. MDMS shall generate reports on the number of meters installed in comparison to the number of meters successfully communicating.

### 1) Meter Data Management

- The MDMS shall accept input, process, store, and analyze Meter data from HES and meter data collected through hand held meter reading instruments and manual meter

reads. In case of manual reads, provision shall be there to insert associated notes like assessed energy, etc.

- The MDMS shall accept input, process, store, and analyze non-billing meter data such voltage and power quality data (like under/over voltage etc.) as they are available from AMI Head End Systems. The MDMS shall also support schedule and on-demand meter reads and pinging of meter energized states by authorized users and by other NEA systems.
- The MDMS shall provide storage of all collected Meter Data, events and alarm. It shall have capacity of storing 5 years data or more via archiving.
- Correctly track & resolve energy usage across meter changes with no loss of individual meter data.
- Provide complete history and audit trail for all data collected from meters including commands sent to meters and other devices for 30 days (configurable period).
- Execute on-demand read processes.
- Handle special metering configurations like net metering/multiple meters at same premises.
- The MDMS shall have the ability to manage at a minimum 15-minute interval data.
- Data Integrity - shall ensure data integrity checks on all metered data received from data collection systems.

## 2) Data Validation, Estimation, and Editing (VEE)

The validation and estimation of metered data shall be based on standard estimation methods. The MDMS shall also support and maintain following data;

- Registered Read Data including register reads, daily billing cycle, as well as derived billing determinants like TOU.
- Interval Data channels with variable intervals and variable units of measure.
- Calculated Data that is derived or computed such as billing determinants and aggregated loads.
- Event data storage of all collected event and alarm data from meters, network equipment, and MDMS itself.

a) MDMS shall flag, alarm and trigger an estimating process including but not limited to when the following anomalies occur in the cumulative ("CUM") register reads;
   i) CUM Decrements within a billing cycle (except net-metering)
   ii) CUM reads increments more than configurable threshold
   iii) Future or old read dates
   iv) Number of digits exceeds number of meter dials

b) MDMS shall detect, flag, alarm and trigger an estimating process including but not limited to when the following anomalies occur in Time of Use (TOU) register reads;
   i) Register Decrements (except net-metering)
   ii) Resets (to zero) (except net-metering)
   iii) CUM reads increments more than configurable threshold
   iv) Future or old read dates
   v) Erratic compared to CUM read (sum of TOU reads minus CUM read)

c) MDMS shall detect, flag, alarm and trigger an estimating process including but not

limited to when the following anomalies occur in Demand register reads;

    i)   Do not reset on cycle

    ii)  Do not reset coincident with customer move-out or move-in

    iii) Reset off cycle inappropriately

    iv) Too high

d) All data shall be transferred to billing system after meter data validation and estimation including transformer / feeder station wise energy audit.

e) MDMS shall estimate usage for non-metered service points such as street lights, farm lights, traffic signals, etc.

f) The MDMS shall maintain both the original received raw data in a non-manipulated state, in addition to VEE data.

g) Notwithstanding the latency of data collection via the AMI system, once the MDMS receives meter read data, the VEE process occurs in real-time and the post-VEE data is then immediately available to user or external systems.

h) The MDMS shall be able to automatically flag data changes from manual edits, VEE (Validating, Editing and Estimating) rules and data source corrections and electronically generate audit trail with timestamps and user-ids

**3) Billing Determinants Calculations**

a) Shall allow configuring multiple TOU/TOD options (e.g. the number and duration of TOU rate periods) by customer type, tariffs and day type (Weekend, Weekdays and Holidays) and by season.

b) Shall support the processing of interval data into billing determinants to include the following at a minimum;

    i)   Total Consumption

    ii)  Consumption in different time blocks for ToU billing

    iii) Maximum Demand (in kW and kVA)

    iv) Number of tamper counts

    v)  Average power factor

c) Shall process interval data and frame it into the appropriate TOU periods for consumption and demand; for example, roll up 15/30-minute data intervals into hourly data.

d) Shall have the ability to properly account for special metering situations such as check metering, sub metering, prepaid metering and net metering when calculating billing determinants and sending them to billing and other systems.

e) Shall have the ability to properly account for special situations including, but not limited to, curtailment requests, demand response scenarios when calculating billing determinants and sending them to be billing software.

**4) Exception Management**

a) Ability to capture and log data exceptions, problems and failures and to generate management reports, provide trend analysis, automate generation of service requests and

track corrective actions.

b) Ability to group, prioritize, filter and send system generated alarms and events to predetermined email addresses, cellular text messages to phone numbers/SMS/customer care etc.

c) Exception Generation - MDMS shall generate exceptions based on configurable business rules including but not limited to the following:

d) Meter tamper alerts

e) Communication module health alerts for Meter

f) If the consumption is less/more than pre-defined average consumption

g) Negative Consumption (not for net-metering)

h) Power outage indications received from the Smart meter

## 5) Service Orders

a) The MDMS shall generate service orders based on configurable rules for various events and alarms such as stop meter, tampers, problem in communication networks, AMI/HES host server, etc.

b) MDMS shall send service orders via SMS, email, etc. with the email addresses / phone numbers being configurable. MDMS shall receive feedback on action taken on the service order and track the status of service orders.

## 6) Consumer Service Support

a) The solution shall provide consumers with access to current and historical consumption and interval data, outage flags, voltage and power quality indications. The data shall be displayed in graphical and tabular form depending on user choice. The consumer may also access data through consumer portal. The solution shall integrate via a user-friendly graphical interface.

b) The MDMS shall support email/SMS notification of configured alarms & events to selected users.

c) The MDMS shall support the web portal or shall have the ability to interface with the third party portal/NEA portal to provide the consumer near real time online views of both usage and cost and helping consumers to understand electricity usage and cost information, alerts and notifications and energy savings tips with different levels of detail. The portal shall support the view for past electricity usage, last week's, yesterday's, current days or other period etc. as per selection. The portal shall provide user friendly access to consumer for their data via colorful graphs and charts and can download the data into a spreadsheet.

d) Shall support Mobile App through which consumer shall be able to log in through android/iOS/Window based mobile app to see information related to his energy consumption? App shall also provide platform for implementation of peak load management functionality by providing existing tariff & incentives rates, participation options etc.

### 7) Analysis

The MDMS shall have analysis capability based on configurable business rules including but not limited to the following:

a) Display consumption/load profiles by configurable period (15/30 min, hour, day, month, year etc.) day type (weekday, weekend, holiday, festival wise etc.) and by tariff, customer type, or any user specified collection of meters.

b) Generate peak & off-peak load patterns by aggregating all loads of DT/Feeder/consumer group.

c) Perform DT/feeder wise energy audit.

d) Perform load analysis for different groups and categories of consumers.

e) Ability to provide the data to load forecasting, load research or demand response applications and perform error management like: Missed reads and intermittent meter reads before taking into forecasting, load research or demand response

f) Ability to configure the system to effectively visualize consumption trends, identify unusual patterns, and visualize load analysis to understand which assets are being over utilized.

g) Analysing data to identify new patterns of usage, Setting fraud alert / transformer overload alerts / demand – supply gap alert etc.

h) Ability to receive and store outage and restoration event data from smart meters and outage systems and to log all such events for analysis.

### 8) Reporting

The solution shall include a list of the standard reports that are provided with the MDMS including but not limited to following:

a) Daily data collection report

b) Usage exceptions

c) VEE validation failures

d) Missing interval Read date and times (on hourly, daily, weekly & monthly basis)

e) Physical meter events (install, remove, connect, disconnect) & meter reset report

f) Meter flags

g) Meter inventory

h) Defective meters

i) AMI/HES performance measurements

j) Threshold Exception

The solution shall support users modifying standard reports to better meet specific reporting requirements.

a) The MDMS shall enable the NEA to deliver reports in standard digital format such as PDF, Excel, etc.

b) Ability for GUI (Graphical User Interface) to set up or change report delivery to configurable email addresses, network file directories, ftp sites or printer systems without modifying source program code and without any proprietary language skills.

c) All queries shall be generated through user driven drop down menu in GUI. The Bidder

shall provide example queries to support internal report generation needs.

d) Ability to provide daily & weekly interface exception reports between MDMS and other subsystems e.g. billing, outage, etc.

e) In case more than one technology of AMI/HES deployed in the field, the MDMS shall generate report on the performance and availability of data being delivered per AMI/HES technology.

Through the usage of MDMS, following list of indicative reports are desired. NEA reserves right to add/remove to the list without any additional financial liability to the NEA;

- Collection of energy flow data from metering module
- Calculation of Bus bar and transformation losses
- Calculation of HT losses
- Calculation of DT losses
- Performance of revenue report
- Generation of report of energy accounting and graphical
- Bill correction/amendment
- Change of billing cycle
- Linking consumer to appropriate tariff
- Contract demand violation
- On Peak/Off Peak load violation
- Tamper counts
- Monitoring of average power factor
- Assessed readings for stopped meter cases
- Comparative for average historical consumption with actual consumption data
- Monitoring of Load factor
- Monitoring of Power Factor
- Monitoring of Utilization factor
- Load duration curves
- Pre-paid vs post-paid (if present)
- Remote Meter Data Reading at configurable intervals (push / pull)
- Remote connection/disconnection at defined/on demand conditions
- Net energy metering (for accurate billing)
- Missing reads (interval/scalar)
- Defective meter

9) **Revenue Protection Support**

a) Ability to analyze meter tampering flags, power outages, usage trends and usage profiles to identify potential energy diversion situations, and produce daily reports, monthly reports and service order requests for investigation.

b) The business rules for revenue protection alerts shall be configurable via a user-friendly interface.

c) The MDMS shall filter out revenue protection alerts that may be caused by field activities if the field activity information is provided to the MDMS.

d) The MDMS shall support the analytics/investigation (i.e. view current and historical usage patterns) to valid suspected revenue protection issues.

## 10) **Demand Control/Demand Response Support**

Bidder shall describe how its MDMS supports Smart Grid Demand Response programs involving Demand Response (DR) systems. The solution shall support the following analysis:

a) Totaling the actual consumption during DR event.

b) Totaling the actual consumption of different groups that participated in the DR event.

c) Comparing the actual to baseline consumption for the groups above.

d) The MDMS shall support the tracking, monitoring and managing of Smart Meter and events, and monitors customer response to facilitate payment of customer incentives.

## 11) **OMS/ other Smart grid functionality Support**

MDMS shall support Smart Grid OMS system as per the requirement of the NEA. MDMS shall support the interfacing with OMS software for providing AMI meter data needed for fault location identification and other requisite services like updating the data after attending the fault etc.

MDMS shall also support the interfacing of other smart grid functionalities like Distribution Transformer Health Monitoring system, self-healing system, electric vehicle etc. as and when implemented by the NEA.

## 12) **Additional Features**

## a) **Net-Metering**

MDMS shall flag, alarm and trigger an estimating process including but not limited to when the following anomalies occur:

i) Cumulative (CUM) decrements of forward energy within a billing cycle.

ii) Register decrements for Time of Use (ToU) of forward energy.

iii) Power generated (exported) by any net-metering consumer more than the installed capacity of solar PV rooftop system.

iv) Energy exported (exported) in any given day by any net-metering consumer more than the programmable threshold value.

## b) **Prepaid Functionality**

The prepaid functionality can either be available in smart meter level or through MDMS. In case of MDMS, following shall apply

i) The MDMS shall support pre-payment metering and capability to interface with pre-payment application.

The aim of the above-mentioned interface standards is to ensure generic two-way interfacing of the MDM with third party applications. Employer shall provide all information of existing system for interfacing with MDM during implementation.

ii) The prepayment shall support the system that payment and connection parameters are stored centrally, and the details are being updated to consumer web portal/ app.

iii) The system shall periodically monitor the energy consumption of prepaid consumer and decrease the available credit based on consumption.

iv) The system shall send connect/disconnect command on available credit as per notified rules & regulations.

v) The system shall send low-credit notifications to the consumer when their balance approaches down to threshold.

## 13) Integration with other Systems

MDM shall interface with other utility systems on standard interfaces, and the data exchange models and interfaces shall comply with CIM / XML / IEC 61968 solutions shall be Service Oriented Architecture (SOA) enabled.

MDM integration with other systems shall include but not be limited to the following:

- Utility Administration
- HES for data exchange with AMI solutions
- Billing and collection system like Base Computing System (BCS)
- Existing other Data Collection Systems
- Support of interface with HHU/CMRI or manual reading system etc.
- Consumer web Portal
- Helpdesk Solution
- Utility OMS and GIS systems

The enhancement on MDM shall be ready for integration with IVRS, CRM, GIS and CIS systems of the utility based on the standard interfaces as mentioned above.

The bidder shall provide at least 50 Number of HHUs & 200 Numbers of Universal Optical Probes to read and update the data in MDM to meet contingency requirement in case of communication failure between meter and HES/MDM.

## 14.) Business Intelligence, Analytics and Reports

The enhanced MDM shall have analysis capability based on configurable business rules including but not limited to the following:

- Display consumption/load profiles by configurable period (15/30 min, hour, day, month, year etc.) day type (weekday, weekend, holiday, festival wise etc.) and by tariff, customer type (hospitals, schools, govt. offices, multiplexes, commercial, residential, industrial etc.), or any user specified collection of meters.
- Generate peak & off-peak load patterns by aggregating all loads of consumer group/consumer type/DT/Feeder over configurable period/day type.
- Perform DT/feeder wise energy audit for configurable period. These energy audit reports shall clearly bring out the technical losses at Feeder level and DT level through detailed analysis of supply side energy data and corresponding aggregated consumption data of connected consumers. In this analysis it must factor in data of energy export from net-metered consumers.
- Perform load analysis for different groups and categories of consumers.
- Ability to provide the data to load forecasting, load research or demand response applications and perform error management like: Missed reads and intermittent meter reads before sharing data with load forecasting, load research or demand response.
- Ability to configure the system to effectively visualize consumption trends, identify unusual patterns, and visualize load analysis to understand which assets are being over utilized.

- Analyzing data to identify new patterns of usage, Setting fraud alert / transformer overload alerts / demand – supply gap alert etc.
- Ability to receive and store outage and restoration event data from smart meters and outage systems and to log all such events for analysis. Five reliability indices shall be calculated as below;
    a. System Average Interruption Duration Index (SAIDI), which is sum of all customer interruption durations in a given period over total number of customers served.
    b. System Average Interruption Frequency Index (SAIFI), which is the total number of sustained interruptions in a given period over total number of consumers served.
    c. Consumer Average Interruption Duration Index (CAIDI), which is sum of all customer interruption durations in a given period over the total number of sustained interruptions in that given period.
    d. Consumer Average Interruption Frequency Index (CAIFI), which is the total number of sustained interruptions in a given period over the total number of distinct consumers interrupted in that given period.
    e. Momentary Average Interruption Frequency Index (MAIFI), which is the total number of customer interruptions less than the defined time (1 or 5 minutes) over the total number of customers served.
- These reliability indices shall be calculated for each month, for individual feeders and aggregated annually for the whole utility. The source data for outage shall be last gasp and the first breath messages from DT/Feeder level meters. These computations shall be independent of similar computations made by any OMS application.
- Ability to alerts on DT/ Feeder level overvoltage & back-to normal event and under-voltage and back-to-normal events. Based on these alerts the system should calculate the duration in which the DT/Feeder remained outside the nominal zone of defined voltage. Similar calculations should be allowed for power factor and current unbalance.
- Identify & visualize poor performing assets like feeder/DT on multiple criteria like energy losses, outage duration etc. through appropriate color coding depending on severity thresholds.
- Analyze data of net-metering consumers to identify patterns of energy export to grid on hourly/weekly/monthly/yearly basis.

## 15. Web Portals and Mobile Applications

### 1) User Interface for NEA Users;
User interface for utility shall have ability for at least the following functionality;
- Compare total energy costs on one rate schedule vs. one or many alternative rates.
- Enable the user to see how different options within a rate affect cost.
- Display meter data at a user defined configurable cycle through a GUI that allows authorized users to view energy usage patterns and the data behind them for selected customers.
- Allow authorized users to view metered data, initiate and view reports, modify

configurations, and initiate and update service requests via a GUI.

- Display via a GUI the energy usage profile for a single meter or group of meters. The load profile shall illustrate energy consumption and peak demand in user defined intervals for a user-specified time period.
- Display via a GUI the energy usage profile for a single meter or group of meters according to Time of Use (ToU) tariff.
- The GUI shall support a configurable utility dashboard for Operations and Utility Management
- Access to a minimum of 5 years of historical energy usage and meter reads through the GUI.
- GUI to clearly and visually distinguish between metered, estimated, allocated and substituted data.
- GUI to provide role-based access based on user identity and user role. Shall have following types of users:
  - Administrator
  - Operator
  - Field staff
  - Viewer/Guest
- Configure the look, feel, and functionality of the MDM in accordance with business needs, business processes, and business conventions. (E.g. GUI, content, look and feel of screens, validation rules, exception handling, etc.).
- Ability for utility through user interface to set up alarm and event notifications that can be directed to a combination of configurable email addresses, cellular text messages or phone numbers.
- User interface for utility to update the credit number of prepaid consumers to MDM. Such type of user interface before login shall require password & login ID for authentication. User interface after getting information like consumer id., mobile number & recharge amount etc. shall update the same to MDM. The details of payment information shall also update to consumer through SMS, email etc.

2) **User Interface for Consumers;**
Customer Portal solution shall be based on Web as well as Mobile based native apps that provide on-line two-way communication between utility and its customers. The solution shall integrate via a user-friendly graphical interface. It shall provide for self service capabilities like usage management, billing, service requests, participation in energy efficiency programs etc. Features shall include;

- The consumer portal solution shall provide customers with access to current and historical consumption and interval data, outage flags, voltage and power quality indications for selected period.
- The Portal/MDM shall support communication preferences for notification via email/SMS of configured alarms & events to selected users.

- The web portal or third party portal/utility portal to provide the consumer near real time online views of both usage and cost differentiating high energy usage periods, helping consumers to understand electricity usage and cost information, alerts and notifications and energy savings tips with different levels of detail. The portal should support the view for past electricity usage, last week's, yesterdays, current days or other period etc. as per selection. The portal should provide user friendly access to consumer for their data via colorful graphs and charts and can download the data into a spreadsheet.
- Consumer mobile app through which consumer shall be able to log in through android/iOS/Window based native mobile app to see information related to its energy consumption. The Mobile App shall also provide platform for implementation of peak load management functionality by providing existing tariff & incentives rates, participation options etc.
- Provide cross-browser compliant software (compatible with Internet Explorer, Chrome, Firefox and Safari)
- The portal shall be linked to the on-line payment facility and gateway of the utility.
- Pre-paid consumers shall be provided facility to recharge their account
- Shall support the utility and in turn its customers with a system for logging, managing, and communicating technical issues.

User interface to consumer portal to access consumer's data from MDM for all authorized consumers shall have ability for at least the following functionality;
- The UI of the portal shall allow selection of preferred language for dialogue like English or any Local language.
- View metered data, initiate and view reports.
- View data according to Time of Use (ToU) tariff.
- Can make request for connection/disconnection.
- User can update mobile number/email.
- Can initiate service requests for maximum demand updating, meter checking etc.
- In case on net-metering consumers, user can view data for both import & export.
- In case of prepaid consumers, consumers can view recharge history & present balance.
- User interface shall require consumer id., mobile number & password for secure login.

Software patches, updates, and minor version upgrades, when they become available for general release, should be part of ongoing support and maintenance services.

### 16. Software Acceptance Testing;

- All types of software tests shall be orchestrated by the bidder and witnessed by the NEA. The software test plans shall contain the following tests for which NEA can appoint a third-party agency for conducting any tests that it deems fit.
- Following software testing phases shall be generally followed in an AMI enhancement implementation.
- Unit testing – Testing of an individual unit or group of related units to verify if the unit produced is not producing any unexpected results.

- Integration testing – Testing in which a group of components are combined to produce output. The interaction between software and hardware shall be tested to identify the software and hardware components relation.

- Incremental Integration Testing – Continuous testing of an application as new functionality is added.

- Functional testing – Testing to ensure that the specified functionality required in the system requirements works.

- System testing – System testing is performed when all the components are delivered to central repository prior to the release of the software. The testing is done on priority basis of business processes. All the defects are logged and assigned to respective component owners. The component and unit testing are performed after the correction of code. However, it may depend on size and type of individual test specifications. Impact analysis is useful to narrow done testing efforts by identifying critical test cases affected due to code change.

- Stress testing – Testing to evaluate how system behaves under unfavorable conditions.

- Performance testing – Although performance testing is described as a part of system testing, it can be regarded as a distinct level of testing. Performance testing will verify the load, volume, and response times as defined by requirements.

- Load Testing – Testing an application under heavy loads, such as the testing of a web site under a range of loads to determine at what point the systems response time degrades or fails.

- Usability testing – Testing is performed to the perspective of the NEA to evaluate how the GUI is user-friendly? How easily can the client learn? After learning how to use, how proficiently can the client perform? How pleasingly to use its design?

- Regression testing – The objective of regression testing is to ensure software remains intact. A baseline set of data and scripts will be maintained and executed to verify changes introduced during the release have not "undone" any previous code. Expected results from the baseline are compared to results of the software being regression tested. All discrepancies will be highlighted and accounted for, before testing proceeds to the next level.

- User Acceptance Testing – User Acceptance testing is the last phase of software testing process before final installation of AMI enhancement system software at NEA and when following prerequisites are met;

- Business Requirements must be available

- Application Code shall be fully developed

- Unit Testing, Integration Testing & System Testing shall be completed

- No Show stoppers, or High or Medium defects in the System Integration Test Phase

- Only Cosmetic errors are acceptable before UAT

- Regression Testing shall be completed with no major defects/deviations.

- All the reported defects shall be fixed and tested

- Traceability matrix for all testing shall be completed

- UAT Environment must be ready

- During the test scenarios definition, for each of the business scenario, an acceptance criterion is defined. Acceptance criteria include expected behavior of the s/w component and the expected results (data). Expected results form a part of the Exit Criteria. In addition to expected result and behaviors, some conditions are also specified in the exit criteria. They can be:

- Number of bugs to be discovered for a functional module. This depends on size of the functionality and is an indicator of amount of testing done.

- If any medium or low-priority errors are outstanding – the implementation risk must be signed off as acceptable by NEA and System Integrator

- All High Priority errors from System Test must be fixed and tested

- Installation Testing – Testing full, partial, or upgrade install/uninstall processes. The installation test for a release will be conducted with the objective of demonstrating production readiness. This test is conducted after the application has been migrated to the client's site. It will encompass the inventory of configuration items (performed by the application's System Administration) and evaluation of data readiness, as well as dynamic tests focused on basic system functionality. When necessary, a sanity test will be performed following the installation testing. After installation, if any bug is reported or there is non-compliance to requirements then a proper procedure shall be followed. End-user shall report ("Change Request") to his/her supervisor about the bug that will in turn get forwarded to Project Manager (PM). PM will forward the list of change request to the bidder after the bug is fixed, it shall be reflected in the production copy after testing it.

- Security/Penetration Testing – How well the system protects against unauthorized internal or external access, willful damage, etc. This type of testing may require sophisticated testing techniques as per NEA guidelines.

- Recovery/Error Testing – Testing how well a system recovers from crashes, hardware failures, or other catastrophic problems.

- Integration of AMI System Components

- The bidder must design and implement an End-to-End Integrated AMI solution and interoperable architecture clearly depicting integration between Smart Meters, Head-End System (HES), Meter Data Management System (MDMS) and other supporting applications. The bidder needs to carry out the integration of AMI system with existing/upcoming MBC system of NEA.

- The proposed architecture shall guarantee the capability of handling up to optimal number of smart meters with high availability, high security and high performance in full load. The software performance shall be tested through virtual metering point simulation tools which will be provided by the bidder.

- The scope of integration with external systems shall include the existing and functional IT systems in NEA and any other system commissioned during the AMI system implementation. The integration is expected to be on-line real time or batch wherever appropriate and shall operate in an automated fashion without manual intervention.

- The Proposed system and overall software solution shall be SOA based integration methodology capable of integrating with external systems (BI, Reporting System, Other MDMS, existing AMR/RMR etc.). The integrated systems shall communicate and exchange data with each other or any other external system as required by NEA and Utilities to generate the following benefits:

- Data Analytics of assets and consumers

- Outage Management

- Alert and Alarm monitoring

- Customized Dashboard

- BI Reports

- Any other external system

- The system shall support the interfacing with the future smart grid functionalities like outage management system, distribution automation including self-healing system, distribution transformer monitoring units, electric vehicle, distributed energy resources etc.

- The System shall accurately maintain system time synchronization across all devices to ensure accuracy of data.

- System and Cyber Security

- The bidder shall provide end-to-end cyber security services to meet IT security challenges for AMI Enhancement System based on the proven frameworks and security best practices. It is vital that the processes and technology supporting the Information Security function for overall software system are proven and compliant to best practices/ standards. It is envisaged that the cyber security operations shall be centralized, structured, coordinated and responsive resulting in effective cyber threat prevention and detection, thereby securing for overall Software System from attackers. The Information Security functions shall respond faster, work collaboratively, and share knowledge more effectively.

- The bidder shall bring advanced data analysis and forensics insight to provide the following services to NEA;

| S. No. | Cyber Security Requirement for AMI System |
|--------|-------------------------------------------|
| 1.     | Security Services for AMI System          |
| 2.     | Firewall Services                         |
| 3.     | IPS Services                              |
| 4.     | HIPS Services                             |

| S. No. | Cyber Security Requirement for AMI System |
|--------|-------------------------------------------|
| 5. | Anti-APT Services |
| 6. | DDoS Services |
| 7. | Anti-Virus Services |

- Security during Design, Supply, Development & Integration Phase

- Shall manage the underlying infrastructure and foundation services, the operating system and the application platform.

- Shall provide services for management of security environment to maintain performance at optimum levels on a 24 x 7 basis.

- The bidder must address ongoing needs of security management including, but not limited to, monitoring of firewall, intrusion detection, content filtering and blocking, virus protection, and vulnerability protection through implementation of proper patches and rules.

- Maintain an updated knowledge base of all the published security vulnerabilities and virus threats for related software and microcode, including, but not limited to, operating systems, application servers, web servers, databases, security solutions, messaging solutions, etc.

- Ensure that patches/work arounds for identified vulnerabilities shall be patched / blocked immediately.

- Responding to security breaches or other security incidents in case of a new threat is observed to ensure that workaround/patch is made available for the same.

- Undertake Management of Security devices, including, but not limited to maintaining firewall services to restrict network protocols and traffic, detecting intrusions or unauthorized access to networks, systems, services, applications or data, protecting email gateways, firewalls, servers, Desktops/Laptops from viruses.

- The bidder shall ensure that the security policy is maintained on an ongoing basis with maintenance and updates to the same are made regularly. Operating system hardening through appropriate configuration and patch updates shall be undertaken on a regular basis.

- Monthly Vulnerability Assessment: Access server for vulnerabilities locally using automated scanning and manual assessment.

- Half Yearly Penetration Testing: The bidder shall perform penetration testing to ensure the following: Create a hacker's view of the server, in terms of the ways it can be hacked from outside. Identify security vulnerabilities and fix holes discovered. Implement emergency quick fix solutions and long-term solutions against successful exploits.

- Firewall Management: Initial setup of the firewall, implementation of rule base on the firewall to enable customer specific applications and ports, implementation of security policies based on services (HTTP, FTP, Telnet), source address / name, destination

address / name, online monitoring of firewall through a central console with 24x7 support, system administration for firewall, including updates & hot fixes that affect its performance, changes in firewall rule base with proper change management and backup of firewall configuration each time there is a configuration change.

- Intrusion Detection and Prevention: Initial installation and setup; applying appropriate levels of risk assessment for specific needs which allows security policies to be an integral part of scanning process; tracking of resource usage for anomalies and logging any suspicious packets from the outside; log maintenance and management; automated network-based security assessment and policy compliance evaluation.

- Testing and Application of Patches: The bidder shall carry out testing and application of periodic patches released by software and OS vendors to plug vulnerabilities in the system.

- Appropriately configure the security groups in accordance with the NEA networking policies. Regularly review the security group configuration and instance assignment to maintain a secure baseline.

- Secure and appropriately segregate/isolate data traffic/application by functionality using DMZs, subnets etc. shall ensure that all systems hosted on it, respectively, are properly monitored for unauthorized activity.

- Properly implementing anti-malware and host-based intrusion detection systems on their instances, as well as any required network-based intrusion detection systems in accordance with NEA policy.

- Conducting regular vulnerability scanning and penetration testing of the systems, as mandated by NEA policy.

- Review the audit logs to identify any unauthorized access to NEA systems.

- The bidder shall address emerging cyber security vulnerabilities in their software & firmware coding under System Development Life Cycle (SDLC). This shall be done by taking into consideration the SANS Top 25 Most Dangerous Programming Errors and the OWASP Top 10 Project.

- The bidder shall propose a legacy data cleansing approach.

- The bidder shall propose a security mechanism to be used for API and adopt the best practices such as OWASP guidelines to ensure security.

- The bidder shall promptly notify NEA when vulnerabilities are found in their code.

- The bidder shall apply security related patches and updates.

- Remote access by the bidder will only be performed using technology authorized by NEA.

- Any data interfaces implemented or built by the bidder will be required to have encryption and authentication (strong authentication when possible.)

- Files containing NEA information shall be transferred using encrypted file transfer techniques agreed upon by both parties.

- Security during Operations phase:

- Security Policy

- The bidder will adopt leading information security framework (such as ISO 27001, ISO 22301) to define, monitor and update security policy (including network, server, application and website/mobile app security).

- Incident Response

- The bidder shall do the analysis of application and network incidents, do post-incident reporting and implement practices to ensure rapid response to attacks.

- The bidder shall do a proactive review of incident response plan to improve incident response time and implement continuous improvement process to strengthen overall effectiveness of security.

- Distributed Denial of Service (DDOS) Protection

- The bidder shall secure complete Software System against DDoS attacks such as network and application level attacks with minimal business disruption.

- Malware Analysis

- The bidder shall conduct analysis of newly discovered malware to uncover its scope and origin. Perform dynamic real-time analysis of advanced malware identified and prevent true zero-day and target attacks which can aggressively evade signature-based defenses through various channels such as Web, Email & Files.

- The bidder shall perform the threat analysis of unwanted or suspicious malwares by the behavior or signature-based deduction and take input from the logs, detection, vulnerability or suspicious activities feeds IOC.

- User Authentication and Control

- The bidder shall define and implement highest level of access governance. The propose of this solution is to have an enhanced user role security where access shall be restricted to only authorized users with multi-factor or two-factor authentication.

- The system shall have access control features for controlling the access rights over the system and over the various functions/features available for different types of users. Best practices from enterprise security including password strength, password aging, password history, reuse prevention etc. must be followed for access control.

- Application user authentication and authorization related transactions shall be encrypted and used a wide array of authentication schemes, standards or token types to ensure that only valid users and applications get access.

- The bidder must ensure that end user access to Data Center and Disaster Recovery Center

- The bidder must ensure that Data Center and Disaster Recovery Center shall have built-in user-level controls and administrator logs for Transparency and audit control.

- Hardening

- All unnecessary packages must be removed and/or disabled from the system. Additionally, all unused operating system services and unused networking ports must be disabled or blocked. Only secure maintenance access shall be permitted, and all known insecure protocols shall be disabled.

- The bidder shall provide consolidated view of the availability, integrity and consistency of the Web/App/DB tiers on Data Center and Disaster Recovery Center.

- The bidder must ensure Database nodes (RDBMS) shall be protected with higher security layer at Data Center and Disaster Recovery Center.

- Security Audit

- The bidder shall engage Security auditor appointed by NEA and cooperate fully with the auditor. The auditors shall be responsible to conduct the following activities:

- Security Audit that include (but not limited to) vulnerability assessment, penetration testing, application security assessment API testing and Mobile application assessment biannually for entire infrastructure.

- Implementation of information security controls and perform periodic assessment.

- Propose ways to enhance the protection of AMI Enhancement System & Supporting IT Infrastructure.

- Ensure the applications are free from OWASP Top10/SANS web/mobile application vulnerabilities as released from time to time.

- The bidder is responsible for mitigating all security risks found and continuous monitoring Activities. All high-risk vulnerabilities must be mitigated within 15 days from the date vulnerabilities are formally identified.

- Source Code Review: Third party agency shall review the source code of applications, web and mobile applications for hidden vulnerabilities and design flaws. It shall also verify whether security controls are implemented appropriately.

- Secure Configuration Review: Third Party Agency shall review the security configuration AMI/HES/MDM Enhancement System and provide the detailed report that include the recommendations for remedial actions and submit the results to NEA.

- In case any major external issue like "Security threat" Or "Cyber Security Incident" occurred due to failure or lack of necessary IT/Cyber Security measures by SI than it will be the responsibility of the bidder to recover all the utility data and systems without loss of any data and business operation. Such incidents of grave magnitude which may result in loss of data, utility business or public image may attract the penalty of at least a quarterly payment or part there-off.

- All the related documentation with complete system architecture shall be provided by the contractor.

# Training to NEA Staff for Operation & Handling of overall System:

The bidder shall provide training to operate and manage offered Smart Energy Meter System & related Software to a total of 500 officers of NEA at different Branch Offices / Distribution Centers as required and shall provide handling support for a period equivalent of two billing cycles to ensure accuracy of the system. The success of the testing shall depend on the extent of independent usage of such technology by NEA officials and hence is important component of this procurement.

The bidder should also provide required Orientation & Hands-on training to a team of 3 officials of respective Branch to conduct Installation of New Smart Meters/ Replacement of existing Electro-Mechanical Meters with New Smart Meters using Mobile Application without any extra cost to NEA.

**Pre-Dispatch Inspection**:
All the routine tests as per IEC62053-21 or latest amendment thereof shall be carried out at the place of manufacturer unless otherwise specially agreed upon by the manufacturer and purchaser at the time of purchases. The manufacturer shall offer to the inspector representing the purchaser all the reasonable facilities, free of charge, for inspection and testing, to satisfy him that the material is being supplied in accordance with this specification. The Company's representative/Engineer attending the above testing will carry out testing as per relevant & this specification and issue test certificate approval to the manufacturer and give clearance for dispatch. Testing procedure shall be followed as mentioned herewith.
All the tests required in this document as well as in bid document shall be carries out during factory inspection. At least 2% of total quantity purchased shall be covered in smart meter accuracy test. At least 2% of the smart energy meters selected for accuracy test shall be conducted for Tamper condition test. At least 2 numbers of meter's components and one meter function test shall be checked during inspection. Any kind of testing failure during inspection shall be subjected to reject the whole manufactured quantity of meters for delivery and shall be penalized.

**Packing**:
Each meter shall be individually packed using blister wrapping to prevent damage during transport and handling. A minimum of ten meters shall be packed in cardboard boxes and the boxes shall indicate Type, Rating and Serial No. of the item. All packing material shall be of bio-degradable type. The Supplier shall take particular care to provide packaging that will securely restrain movement of meters within the individual packages by use of shock absorbent, non-marring materials such as thermo-cole. Group packaging shall be sturdy, weather resistant, and be capable of continuing NEA use after initial delivery. The packaging of each meter shall contain moisture absorbent.

**Joint Inspection After Receipt At Stores (Random Sample Testing):**
From each lot (lot means the total number of meters received in a Store out of inspected and approved lot by purchaser's representative under one approval letter) of meters received at Stores, 5 sample meters shall be drawn and these meters will be tested by Our Testing Engineer in presence of Supplier/Manufacturer's representative jointly for (i) no load condition,(ii) limits of error test (iii) starting & (iv) repeatability of error test and (v) tamper conditions as per this

specification. The 15 days in advance intimation will be given to the supplier and if the supplier/manufacturer fails to attend the joint inspection on the date informed, the testing will be carried out by our Testing Engineer in absence of Supplier/Manufacturer representative. If the meters failed in above random sample testing, the lot will be rejected. (If any types of fault occurrence in the meter after installation billing surplus given by meter shall be paid by bidder within warranty period).

**Guaranteed Technical Particulars**:
The technical particulars as specified in IEC shall be guaranteed and statement of guaranteed technical particulars shall be furnished along with tender as per given "Schedule Of Guaranteed Technical Particular". The offered Smart Energy Meters shall have been designed and manufactured by using make of Component as per given "List of Components Make for Smart Energy Meter"

**Drawings Leaflets:**
Two sets of drawing showing clearly the general arrangements, fitting details, electrical connections and design features of each component part shall accompany the tender. Technical leaflets or brochures giving operating instructions shall also be furnished along with the tender. TENDERS without DETAILS ARE LIABLE FOR REJECTION.

**User's Manual:**
The supplier shall furnish the operation & maintenance manual of the Meter offered and the required software for the smooth functioning of the meter.

**Departure from Specification:**
If the supplier wishes to depart from this specification in any respect, he shall draw the attention to such points of departure explaining fully the reasons thereof. Unless this is done, the requirements of this specification shall be deemed to have been accepted in every respect.


**Sample**:
The successful bidder shall submit one sample meter as per tender specification with manufacturer's seal to the office before mass production. Functional Tests shall be carried out upon the sample meter.

**Functional Tests:** Remote Meter Reading/Writing, Main Relay Connection/Disconnection Functions using Base Computer Software (BCS) provided by bidder over GPRS and RF/PLC.
Basic Prepaid Function Test using Consumer Interface Unit (CIU) and Base Computer Software (BCS) provided by bidder.

**Sample Communication scheme Meter-HES-MDMS-HES-Meter**

| Sr. | Use Case Activity Description | Source | Destination | Info Exchanged |
|---|---|---|---|---|
| 1. | **Collection of Daily Meter Profile** | | | |
| 1.1 | At scheduled frequency HES/meter should pull/push the Daily Meter Data from Smart Meter over communication Channel | HES/ meter | Meter/H ES | Meter Number, reading date & time, kW, kVA, kWh, kVAh, PF, Non-critical Event Code / Date |
| 1.2 | Meter should send the data to HES. Provision for retrial should be there if Meter data is not collected within time. Consumption details including non-critical events will be in 15 min/30 min block data, and data could be incremental to what was sent by meter in preceding instance | Meter | HES | Meter Number, reading date & time, kW, kVA, kWh, kVAh, PF, Non-critical Event Code / Date |
| 1.3 | HES should send the data to MDM | HES | MDM | Meter Number, reading date & time, kW, kVA, kWh, kVAh, PF |
| 1.4 | MDM should send the required parameter to Prepaid system for daily charge calculation at least once on daily basis | MDM | Prepaid Engine | Meter Number, reading date & time, kW, kVA, kWh, kVAh, PF, Non-critical Event Code / Date |
| 2. | **Monthly Billing profile collection** | | | |
| 2.1 | Command from Billing system triggered and send to MDM / HES for collection of Monthly billing Data | Billing System | MDM / HES | Meter Number, reading date & time, kW, kVA, kWh, kVAh, PF, Non-critical Event Code / Date |
| 2.2 | At scheduled frequency HES should pull the monthly meter data from Smart Meter over the communication channel | HES | Meter | Meter Number, reading date & time, kW, kVA, kWh, kVAh, PF, Non-critical Event Code / Date |
| 2.3 | Meter should send the data to HES. Provision for retrial should be there if Meter data is not collected within time. | Meter | HES | Meter Number, reading date & time, kW, kVA, kWh, kVAh, PF, Non-critical Event Code / Date |
| 2.4 | HES should decrypt and validate the data collected and send to MDM | HES | MDM | Meter Number, reading date & time, kW, kVA, kWh, kVAh, PF, Non-critical Event Code / Date |
| 2.5 | MDM should send the required parameter to Billing system for Monthly Bill calculation | MDM | Billing Engine | Meter Number, reading date & time, kW, kVA, kWh, kVAh, PF, Non-critical Event Code / Date |

| 3. | **Remote Meter disconnection** | | | |
|---|---|---|---|---|
| 3.1 | Meter disconnect operation command after wallet balance calculation | Prepaid Engine / Billing system | MDM | Meter Number, group of meters, instruction to close switch |
| 3.2 | Disconnection alert sent to consumer | MDM | Billing System | Meter Number, group of meters, instruction to close switch |
| 3.3 | Meter disconnection operator command | MDM | HES | Meter number, action (disconnect) |
| 3.4 | Consumer meter disconnection | HES | Meter | Meter Number, switch status |
| 3.5 | Disconnection Status Update | Meter | HES | Meter Number, switch status |
| 3.6 | Disconnection Status Update | HES | MDM | Meter Number, switch status |
| 4. | | | | |
| 4.1 | Meter reconnect operation command after wallet **Remote Meter Reconnection** recharge Billing | Billing system / Prepaid Engine | MDM | Meter Number, group of meters, instruction to close switch |
| 4.2 | Meter reconnect operation command | MDM | HES | Meter Number, group of meters, instruction to close switch |
| 4.3 | Consumer meter reconnection | HES | Meter | Meter number, action (reconnect) |
| 4.4 | Reconnection Status Update | Meter | HES | Meter number, action (reconnect) |
| 4.5 | Reconnection Status Update | HES | MDM | Meter number, action (reconnect) |
| 5. | **Utility detects tampering at consumer site** | | | |
| 5.1 | High priority events captured by Meter sent to HES as and when occurred | Meter | HES | Meter Number, event date & time, event Code /description |
| 5.2 | High priority events reach MDM for further action. | HES | MDM | Meter Number, event date & time, event Code /description |
| 5.3 | Share with WFM to Notify utility personnel for site inspection | MDM | WFM | Consumer number, Meter Number, Tamper code, address |
| 5.4 | On analysis and detection of valid tamper event or malfunction, the | Meter | HES/ MDM | Consumer number, meter number, action to be |

| | | | | |
|---|---|---|---|---|
| | tamper event must be sent / pushed by the meter to the HES /MDM | | | triggered (disconnect), action date & time |
| 5.5 | HES sends disconnect command to meter | HES | Meter | Meter Number, action (disconnect) |
| 5.6 | Tamper event shared with CIS/CRM. Billing determinants are updated for tamper invoicing | MDM | CIS / CRM | Meter Number, event date & time, event Code /description |
| 5.7 | Meter re-connection order once tamper issue is resolved | MDM | HES | Meter number, action (re-connect) |
| 5.8 | HES sends re-connect command to meter | HES | Meter | Meter Number, action (re-connect) |
| 6. | **Missed interval readings** | | | |
| 6.1 | On identifying missed interval, HES will re-acquire data for the missing period from meter | HES | Meter | Meter Number, from date & time, to date & time (for which data is missing) |
| 6.2 | On receiving data request command, meter will send data to HES | Meter | HES | Meter Number, reading date & time, kW, kVA, kWh, kVAh |
| 6.3 | Missed Interval and Reads Data acquired by MDM | HES | MDM | Meter Number, readings with date & time |
| 7. | **Consumer connection outage/restoration event** | | | |
| 7.1 | Outage/restore event recorded by meter is sent to HES as and when event occurs | Meter | HES | Meter Number, Outage / restoration Date / Time, Power On or Off count |
| 7.2 | Outage / Restoration Notification | HES | MDM | Meter Number, Outage / restoration Date / Time, Power On or Off count |
| 7.3 | Sharing Outage / Restoration Notification | MDM | NOMS/ CIS-CRM | Meter Number, Outage / restoration Date / Time, Power On or Off count |
| 7.4 | Meter read request from OMS to identify service outage / restoration | OMS | MDM → HES | Meter Number, |
| 7.5 | Meter responds to event poll from HES | Meter | HES | Meter number, Status (live/dead) |
| 8. | **Remote firmware upgrades/ meter configuration changes** | | | |
| 8.1 | Remote firmware upgrade | HES | Meter | Firmware |
| 8.2 | Configuration Commands: Change tariff parameters, Synchronize clock, Registers reset (status, max, tampering) | HES | Meter | Meter number, tariff parameters, registers status, event type and priority |
| 8.3 | Status update of Firmware / Configuration | Meter | HES | |
| 9. | **Load monitoring at demand side** | | | |
| 9.1 | When there is a load violation event recorded in the meter, the information is sent to the CC | Meter | HES → MDM | Meter Number, max demand, date & time of load violation |

| 10. | **Time synchronization** | | | |
|---|---|---|---|---|
| 10.1 | Synchronizing RTCs of meters / DCUs/ACP | HES | DCU/Meter | Time Setting |
| 11. | **Metering network changes** | | | |
| 11.1 | Change / new installation in Meter / DCU Network Hierarchy | Meter / DCU | HES | Network identification info including DCUs |
| 11.2 | Change / new installation in Meter / DCU Network Hierarchy | HES | MDM | Network identification info including DCU |
| 12. | **New consumer connection** | | | |
| 12.1 | Receive verified pre & post-paid new consumer requests | CIS-CRM/ Billing | MDM | Consumer name, address. Connection request etc. |
| 12.2 | Generate meter installation order | MDM | /WFM | Consumer ID & details |
| 12.3 | Receive meter installation report | WFM | MDM | Meter number, DT no, Feeder & reading |
| 12.4 | Requesting instant, interval & events data from meters | MDM | HES → Meter | Meter Number, Reading date & time, reading params (kWh, kVAh, kW etc.) |
| 12.5 | Acquire instant, interval / events data from meter by HES which then reaches MDM system. | HES | MDM | Meter Number, Reading date & time, reading params (kWh, kVAh, kW etc.) |
| 12.6 | Once new meter remote read verification is over, confirm new connection with other applications | MDM | Billing / CIS-CRM | Consumer ID, Consumer address, Meter Number, initial reading etc. |
| 13. | **Migrate post-paid consumer to prepaid mode** | | | |
| 13.1 | Receive migration request | CIS-CRM/ Billing | MDM | Migration request for post-paid consumer with profile |
| 13.2 | Setup prepaid consumer profile in prepaid engine. If no change in meter is required, skip next two steps | MDM | Prepaid Engine | Prepaid consumer profile |
| 13.3 | Generate prepaid meter installation order if required | MDM | WFM | Consumer ID & details |
| 13.4 | Receive meter installation report | WFM | MDM | Meter number, DT no, Feeder & reading |
| 13.5 | Enable prepaid mode in meter | Prepaid engine | HES → Meter | Engineering token |
| 13.6 | Receive activation confirmation | HES | MDM | Activation status |
| 13.7 | Request instant, interval & events data from meter | MDM | HES → Meter | Meter Number, Reading date & time, reading params (kWh, kVAh, kW etc.) |
| 13.8 | Acquire instant, interval / events data from meter by HES which then reaches MDM system. | HES | MDM | Meter Number, Reading date & time, reading params (kWh, kVAh, kW etc.) |
| 13.9 | Once meter remote read verification is | MDM | Billing / | Prepaid consumer profile |

| | | | | |
|---|---|---|---|---|
| | over, share migration request completion detail with other modules | | CIS-CRM | |
| 14. | **Migrate prepaid consumer to post-paid mode** | | | |
| 14.1 | Receive migration request | CIS-CRM | MDM | Migration request for prepaid consumer with profile |
| 14.2 | Request meter data | MDM | HES → Meter | Meter Number, Consumer ID |
| 14.3 | Acquire instant, interval / events data from meter by HES which then reaches MDM system. | HES | MDM | Meter Number, Reading date & time, reading params (kWh, kVAh, kW etc.) with balance credit |
| 14.4 | Send meter disconnect command | MDM | HES → Meter | |
| 14.5 | Receive connection status | HES | MDM | Disconnect status |
| 14.6 | Enable post-paid mode in meter | MDM | HES → Meter | Engineering token |
| 14.7 | Receive activation of post-paid mode | HES | MDM | Activation Status |
| 14.8 | Request instant, interval & events data from meter | MDM | HES → Meter | Meter Number, Consumer ID |
| 14.9 | Acquire instant, interval / events data from meter by HES which then reaches MDM system. | HES | MDM | Meter Number, Reading date & time, reading params (kWh, kVAh, kW etc.) |
| 14.10 | Once meter remote read verification is over, share migration request completion detail with other modules | MDM | Billing / CIS-CRM | Post-paid consumer profile and meter data along with credit balance |
| 15. | **Consumer Registration in Consumer Portal/ App** | | | |
| 15.1 | Consumer clicks on new user on consumer portal/ App, provides RMN or email ID and submits data | Portal/ App | CIS/CRM | Request for registration with RMN/email ID |
| 15.2 | Utility receives request for registration and sends OTP after verification | CIS/CRM | Email/Message Gateway | OTP |
| 15.3 | Consumer submits OTP | Portal/ App | CIS/CRM | |
| 15.4 | Consumer receives registration detail | CIS/CRM | Email Gateway | Login ID and default password |
| 15.5 | Consumer submits first login request | Portal/ App | CIS/CRM | |
| 15.6 | System seeks password change | CIS/C | Portal/ App | |

| | | | RM | | |
|---|---|---|---|---|---|
| 15.7 | Consumer changes default password | Portal/ App | CIS/CR M | |
| 16. | **Consumer Access to Consumption, Billing & Profile Data** | | | |
| 16.1 | Consumer logs in to Portal/ App | Portal/ App | MDM | |
| 16.2 | Consumer Profile for Portal/ App | CIS-CRM | MDM →Portal / App | Name, Account, Address, Service Points, K Number |
| 16.3 | Consumption Data | MDM | Portal/ App →UI | Consumption profile |
| 16.4 | Billing (post-paid) / Credit Balance (prepaid) | Billing → MDM | Portal/ App | Post-paid Billing history/ Current Bill, Prepaid Recharge history |
| 17. | **Prepaid Consumer Recharge** | | | |
| 17.1 | Consumer logs into Portal / Mobile App | Mob App / Portal | UI | Login |
| 17.2 | Consumer fills-in required detail in UI and requests recharge | UI→ Prepai d App | Payment Gateway | Consumer ID, Recharge amount |
| 17.3 | Consumer selects payment method | Payme nt Gatew ay | Net banking /Credit Card / Wallet etc. | |
| 17.4 | Consumer receives payment acknowledgement | Payme nt Gatew ay | Prepaid App→P ortal→U I | |
| 17.5 | Calculate credit balance for prepaid consumer & update prepaid meter | Prepai d App | HES→ Meter | Consumer credit balance (virtual token) |
| 17.6 | Notify credit balance to consumer | Prepai d App | Email/S MS Gateway | Credit Balance |

| 18. | **Post-Paid Consumer Bill Payment** | | | |
|---|---|---|---|---|
| 18.1 | Consumer logs into Portal / Mobile App | Mob App / Portal | UI | Login |
| 18.2 | Consumer is presented with Billing history and current outstanding Bill | Billing → MDM | Portal/ App→UI | Outstanding Bill |
| 18.3 | Consumer requests bill payment. Option to download bill | UI→Billing | Payment Gateway | |
| 18.4 | Consumer selects payment method | Payment Gateway | Net banking /Credit Card / Wallet etc. | |
| 18.5 | Consumer receives payment acknowledgement | Payment Gateway | Billing → Portal/ App→UI | |
| 18.6 | Payment acknowledgement through email/SMS | Billing | Email/SMS Gateway | Payment acknowledgement |
| 19. | **Consumer Service Request** | | | |
| 19.1 | Consumer logs in to Portal/ App | Portal/ App | CIS/CRM | |
| 19.2 | Consumer requests for service | UI | CIS/CRM | Service request |
| 19.3 | System assigns SRN & sends acknowledgement | CIS/CRM | Portal/ App→UI, Email/SMS Gateway | |
| 19.4 | System resolves request & updates consumer records | CIS/CRM | Portal/ App→UI, CIS/CRM | |
| 19.5 | System closes SRN | CIS/CRM | Email/SMS Gateway | |

| 20. | **Consumer Complaints** | | | |
|---|---|---|---|---|
| 20.1 | Consumer logs into Portal/ App | Portal/ App | CIS/CRM | |
| 20.2 | Consumer registers complaint | UI | CIS/CRM | Specific complaint |
| 20.3 | System assigns CRN & sends acknowledgement | CIS/CRM | Portal/ App→UI, Email/SMS Gateway | |
| 20.4 | System assigns resolution based on nature of complaint | CIS/CRM | CIS / OMS / WFM | |
| 20.5 | Target system reports completion of complaint | OMS / WFM | CIS/CRM | |
| 20.6 | System updates records and closes CRN | CIS/CRM | CIS, Email/SMS Gateway | |
| 21. | **Demand read of meters from consumer premises** | | | |
| 21.1 | Requesting instantaneous, interval, load profile & events data from meters | MDM | HES→ Meter | Meter Number, Reading date & time, reading params (kWh, kVAh, kW etc.) |
| 21.2 | Acquire instant, interval, load profile & events data from meters by HES which then reaches MDM system. | Meter → HES | MDM | Meter Number, Reading date & time, reading params (kWh, kVAh, kW etc.) |
| 22. | **Staff User Access to Utility Portal** | | | |
| 22.1 | User logs in to Portal | Portal | MDM | Login with appropriate credentials |
| 22.2 | User selects available functions | MDM | Portal → UI | |
| 22.3 | User logs out | Portal → UI | MDM | |

## Sample reports generated from MDM

| (ii) Category | Report | Frequency |
|---|---|---|
| Energy Audit | Energy Audit Report (DT/ Feeder / Sub-Division/ Division/ Circle wise) in contiguous electrical locations:<br>• A daily automatic feeder loss | Daily, Monthly and User Selectable Time Period with configurable near real time alerts for |

| (ii) Category | Report | Frequency |
|---|---|---|
| | report (Feeder Head reading minus summation of all DT meters readings)<br>• Automatic LT Energy loss report (DT meter reading minus summation of readings of all those consumer meters served by the selected DT) would be reported<br>• Billing and collection efficiency<br>• Identify the top 10 best as well as worst performing feeders and DTs | exceeding defined loss threshold |
| Reliability Indices | SAIFI and SAIDI; CAIFI and CAIDI; MAIFI of the feeder(s) and connected consumers would be tracked to measure the improvement in the same overtime and establishing reference levels | Daily, Monthly and User Selectable Time Period |
| Load Management | DT Loading (Categorize DT as overloaded, optimally loaded, near optimal, under loaded) | Daily, Monthly and User Selectable Time Period with configurable near real time alerts |
| | Load recording (Consumers): Actual consumption recorded higher than the sanctioned load identifying the top 100 consumers | Daily, Monthly and User Selectable Time Period with configurable near real time alerts |
| | Load Management Report (Identify top overloaded DTs) and load rise trend | Monthly and User Selectable Time Period |
| Power quality | Voltage Deviation Index and Frequency Deviation Index (DT/ Feeder) | Daily, Monthly and User Selectable Time Period with configurable near real time alerts |
| | Low Power Factor (DT/ Feeder) | Daily, Monthly and User Selectable |

| (ii)      Category | Report | Frequency |
|---|---|---|
|  |  | Time Period with configurable near real time alerts |
|  | Meter Current Unbalance (DT/ Feeder) | Daily, Monthly and User Selectable Time Period with configurable near real time alerts |
| Loss Analytics | Tamper Alert: as per IEC | Daily, Monthly and User Selectable Time Period with configurable near real time alerts |
|  | Comparison Consumption (system used to detect & track theft suspects) |  |
|  | Consumption lower than the expected pattern (pattern of previous year applied to the monthly average) or monthly average |  |
| Management Summary Report (Dashboards) | Summary report on top 10 high loss DTs/ Feeders, top overloaded DTs/ Feeders, Top feeders/ DTs with most outages (number and duration), Top feeders with most power quality issues (over voltage, under voltage, current unbalance, out of band frequency), DTs with high failure rate | <Monthly and User Selectable Time Period> |

# Operation and Maintenance

## Scope and period

The operation, maintenance, and support services start after the successful completion of the operational go-live of the system as per Clause 9.6 of this Section. Operation, maintenance and support services shall extend up to end of Total Meter-months from Operational Go-Live. The scope of work under operation and maintenance services shall include,

a) Comprehensive maintenance of all the software (including licensing, version upgrades if any and annual technical support cost)

b) Comprehensive maintenance of all hardware at the Operation and Monitoring Centre, along with field devices (like Smart Meters, DCUs etc.) provided by AMI Service Provider under the project

c) Comprehensive maintenance of all equipment under leased service like cloud data Centre, MPLS band width etc.

d) Comprehensive maintenance of NAN / WAN communication infra between field devices and the cloud data center

e) Day to day operations of the AMI system under supervision and authority of the Utility. These shall include among others,

   i. New meter installation
   ii. Changeover of consumer meters from post-paid to prepaid mode and vice versa
   iii. Firmware update of remote devices (Meters and DCUs) as required
   iv. Update of tariff slabs
   v. Ensuring completion of recharge cycle of prepaid consumer meters
   vi. Connecting, disconnecting or reducing consumer's licensed load under approval from the Utility
   vii. Initiating resolution of consumer trouble tickets raised by utility CCS
   viii. Ensuring availability of BP, LP, interval data and event notifications from meters in time schedules as agreed with the utility
   ix. Ensuring scheduled completion of billing determinant calculations
   x. Ensuring daily reports from the AMI system as per agreed list, are made available to utility
   xi. Ensuring Consumer Portal is kept updated
   xii. Ensuring smooth data traffic between the MDM and utility systems
   xiii. Patch management of AMI applications at cloud data centre
   xiv. Provide backup data to support SLA and AMI Service Provider invoicing
   xv. Carry out performance checks of various functions as per agreed schedule or on demand

As part of their Operation and Maintenance responsibilities, the AMI Service Provider shall develop a compendium of Operation and Maintenance Manuals covering the areas mentioned in serial number e), Clause 7.1 of this Section. These manuals shall be kept updated as often as necessary to reflect best practices being employed in the project.

The AMI Service Provider is to hand hold the Utility team to take over operation, maintenance and support services after completion of contract period. The project/ system devices should allow their functionalities to be upgraded without disruption to the existing functionalities by downloading new software and configuration information.

The AMI Service Provider shall make available the following man-power resources at the utility's Network Operations cum Monitoring Centre,

a) One resident Project Manager cum Supervisor,
b) [Three] numbers operations staff
c) [One] support engineer for each category of hardware supplied and
d) [One] software specialists for each domain.

The above-mentioned operation and support staff shall be made available as required to meet the SLA and system availability requirements. Re-distribution of any support engineer/specialist at the cloud Data Centre shall be at the discretion of the AMI Service Provider.

It shall be the responsibility of the AMI Service Provider to collect meter data through handheld meter reading instruments for the balance meter data reads not fulfilled by the automated remote reading process. Similarly, if the remote connect / disconnect facility fails, it shall be the AMI Service Provider's responsibility to manage the function locally.

**Maintenance Practices (Remain to Study)**

For all third-party equipment (Hardware & Software) AMI Service Provider shall have back-to-back support along with supply of spare with appropriate response time from OEM/OEM (original equipment manufacturer) Authorized representatives. AMI Service Provider shall be responsible for coordination with the OEM for all matter related to equipment.
The maintenance practice followed by AMI Service Provider shall be in accordance with best industry practices and must include the following:

a) Scheduled preventive maintenance, performance monitoring, system backup, hardware & software maintenance and update, field & network devices firmware update, emergency response and troubleshooting etc.
b) Maintaining adequate spares for maintenance.

**Preventive Maintenance Activity**

The preventive maintenance activities shall be performed by the AMI Service Provider to keep the system running at optimum level by diagnosis and rectification of all hardware and software failures and would broadly include:

a) Repair / replacement of defective equipment

b) Configuration of the replaced hardware and software, periodic routine checking as part of a preventive maintenance program

c) Monitoring of the performance of the system and doing necessary tuning for optimum performance to accommodate any changes such as addition of new components

d) Providing all necessary assistance to the Utility for addition and modification of utility user interface, consumer Portal/ App displays, and Database

e) Ensure Backup of the system at regular interval which is mutually decided during system design

f) Restoration of the systems upon its failure and to restore the functioning of the various application / systems at the cloud data centre. Towards this, the RPO and RTO shall have to be measured no less than once a month.

### Integration of Equipment

All future services, protocol emulations and configuration support for integration of Smart Meters/ nodes, routers, access points, network devices, web services, integration with other offline applications etc. shall be the responsibility of AMI Service Provider and shall be part of the maintenance activities.

### Spares inventory

As part of project implementation plan, the AMI Service Provider shall detail the spares inventory that shall be maintained for the AMI Project. These spares shall be used as and when required by the AMI Service Provider for the project and no separate charges shall be payable. The AMI Service Provider shall decide the items and components to be maintained as spare.

### Monitoring

The operation and performance of the various systems shall be monitored on a continuous basis. The AMI  Service Provider shall conduct at least the following monitoring:

a) MDM / HES system error history logs or selected day
b) Field & Network device failure – rate and trends
c) Availability of various communication links
d) Missing meter data – rate and trend
e) Reviewing resource information
f) Cyber Security

During monitoring if any defect/ abnormality is found, the AMI Service Provider shall undertake corrective maintenance for the same. The Utility's UI shall be kept updated with a summary of such monitored data.

### System Cyber Security Monitoring

The AMI Service Provider shall also be responsible for monitoring of the system from cyber security perspective. The logs of the system shall be analysed for exceptions and the possible incident of intrusion/trespass shall be informed to the Utility and analysed to discover root cause.

The monitoring shall encompass all cyber security devices installed at the cloud data centre as well as at the NOMC such as firewalls, all types of Intrusion prevention system, routers etc.

The Cyber security system shall also be subjected to Annual Security Audit from CERT-In listed auditors at the cost of the AMI Service Provider during the contract period. AMI Service Provider shall share with Utility such audit reports and implement the recommendations/remedial actions suggested by the Auditor.

**Physical Maintenance**

The AMI Service Provider shall undertake physical maintenance of all equipment/modules under the scope of this contract, in accordance with the schedule as indicated by AMI Service Provider in project implementation plan. The physical maintenance shall include cleaning, dusting, inspection of equipment for loose connections, damage to insulation, pest infections etc. Equipment shutdown during preventive maintenance shall be deemed as available.

**Service Level Agreement (SLA)**

Service Level Agreement (SLA) shall be monitored as mentioned in the following table. It is expected that the AMI system shall meet the minimum threshold of service defined against each level. Any degradation below this minimum threshold will attract penalties as per bands of service level met. The idea is that it triggers a proper review of any defect / failure / performance that had been agreed upon for the project, and to find resolutions in keeping with the highest standards of service excellence. The total penalties under SLA categories are capped at 5% of AMI Service Provider Service Charge. AMI Service Provider shall ensure that the data collection and computation for the purpose of SLA penalties should be automated and visualized in Utility Interface.

**Duties of Utility and AMI SERVICE PROVIDER during Operations and Maintenance Phase**

The table in this section provides a summary definition of the roles and responsibilities of the AMI Service Provider and the Utility during operation and maintenance phase of the AMI Project.

Legend:
- This indicates who has primary responsibility to perform this function
  A: This indicates who will provide assistance
  F: Feedback

| Item | Task | Utility | AMI SERVICE PROVIDER |
|------|------|---------|----------------------|
| **1.0** | **Problem Identification** | | |
| **1.1** | Root cause analysis to determine whether the fault is attributable to Hardware or Software. | F | • |
| **1.2** | Resolution of problems involving third party maintainer where there is uncertainty whether the root cause is hardware or software. | A | • |
| **2.0** | **Software Problem Resolution** | | |
| **2.1** | Report problem and assist with problem identification | F | • |
| **2.2** | Provide or recommend corrections, temporary patches, workarounds or other fixes to system problems | F | • |
| **2.3** | Install and test corrections, temporary patches, workarounds or other fixes to system problems | F | • |
| **3.0** | **Routine Software (including MDM, HES, Utility Interface, Consumer app/portal) Support** | | |
| **3.1** | Build and maintain database, displays and reports | F | • |
| **3.2** | Perform system back-ups | F | • |
| **3.3** | Restore or reinstall software from back-ups | F | • |
| **3.4** | Monitor system logs (part of remote monitoring service) | F | • |
| **3.5** | Maintain system logs | F | • |
| **3.6** | Maintain user accounts | A | • |
| **4.0** | **Hardware (including meter, DCUs, routers, network** | | |

| Item | Task | Utility | AMI SERVICE PROVIDER |
|---|---|---|---|
| | **operation and monitoring center etc.) Problem Resolution** | | |
| **4.1** | Report problem and assist with defining problem | A | • |
| **4.2** | Troubleshoot problem to diagnose if it is software- related or hardware-related | F | • |
| **4.3** | Identify failed component, replace failed components in the system using parts from spares inventory | F | • |
| **4.4** | Restore operation of repaired/replaced equipment | A | • |
| **5.0** | **Hardware Spare Parts** | | |
| **5.1** | Manage local spares inventory | F | • |
| **5.2** | Replenish local spares inventory | F | • |
| **6.0** | **Integration and Database Work at NOMC End** | | |
| **6.1** | Field Device Integration | A | • |
| **6.2** | Other System Integration | A | • |
| **7.0** | **Cyber Security Monitoring** | | |
| **7.1** | Patch Updates | F | • |
| **7.2** | Cyber Security Monitoring | F | • |
| **7.3** | Annual Audits | F | • |
| **7.4** | Implementation of Recommendations during Audit | F | • |
| **8.** | **Manual Meter Read Through HHU In Case of Non-Communication of Smart Meters** | A | • |

# Training Requirements

**Training Categories**

The AMI  Service Provider  is required to organize following categories of training for the Utility personnel:

a) **Professional Training** - This is the training for the core group of implementation team of the Utility. This team will comprise of members from all the Business Functions and IT sections. Each member would be trained in the relevant function/ module. This Training would be required to be given to approximately 20 personnel. It is the responsibility of AMI  Service Provider to deliver this training. Standard curriculum designed and agreed by the Utility for

hardware, software and network preferably shall be arranged by the AMI Service Provider for each group. The Utility will prefer if a portion of the training is conducted on-site.

b) **End User Training** - The AMI Service Provider will provide training to the owner's team on a "Train the Trainer" basis. The Utility's team so trained will then train all of the Utility's end users. It is estimated that this training will require around 30 groups, with each group comprising of around 10 persons. These training sessions will be required to be conducted at any of the sites. The recommended training material can be in paper / electronic media with courses on Business Process Automation software fundamentals, business process overview, job activity training, and delivery options being on-line, CBTs, instructor led classrooms, etc.

**Training modules**

The training modules shall include but not be limited to the following.

a) AMI Administration & Configuration
b) AMI Installation and troubleshooting
c) Application Management and Operations
d) Database and Data Analysis Reports
e) Cyber Security
f) Smart Meter and communication technology

An indicative list of training is as provided below.

| Item No. | Description | No. of Trainees | Duration in weeks | | Total Man-weeks | |
|---|---|---|---|---|---|---|
| | | | At Utility's facility | At AMI Service Provider's facility | At Utility's facility | At AMI Service Provider's facility |
| 1 | Smart Grid components Hardware and Software Course | 30 | 1 | 1 | 30 | 30 |
| 2 | Database, Report and Analytic Building Course | 10 | 1 | 1 | 10 | 10 |
| 3 | Application Software | 20 | 1 | 2 | 20 | 40 |
| 4 | Operator training & Maintenance course | 40 | 1 | 0 | 40 | 0 |
| 5 | Smart Meter & Communication network | 15 | 1 | 0 | 15 | 0 |
| 6 | Cyber Security Training course | 5 | 0 | 1 | 0 | 5 |
| Total | | 120 | 5 | 5 | 115 | 85 |

**General Requirements for Training**

General requirement for training to be imparted is as follows:

a) Training shall be conducted by AMI Service Provider personnel who are experienced instructors and speak understandable English language.

b) The AMI Service Provider shall provide training to various user groups nominated by the Utility. The AMI Service Provider shall provide the Training Approach in the response

c) All necessary training material shall be provided by the AMI Service Provider. Each trainee shall receive individual copies of documents used for training. Training material shall be organized by functional process that will serve as the training documentation for a particular functional area.

d) Training materials, including the documents provided to the trainees as well as handouts, shall become the property of the Utility. The Utility reserves the right to copy such materials, but for in-house use only.

e) For all trainings the travel expenses of the Utility will be borne by the Utility.

f) The schedule, location, detailed contents, for each course shall be finalized during detail engineering. The number of participants in the training program may undergo change. However, all the training courses shall preferably be conducted in single batch. Training shall be done in batches comprising of Introduction, Basic and Advanced categories.

g) The training will consist of a curriculum of courses to address the issues of system operation, system troubleshooting, business-wide application, changed business processes and general use of the new system.

h) Representatives from the AMI Service Provider, Utility's project management teams will be involved throughout in the development of training strategy, training material design and development, standards and training delivery to ensure that change management issues are incorporated, and that training strategies and materials are aligned to the requirements of the project and as business-specific as possible.

i) Two Engineer's from the Utility shall be stationed at the AMI Service Provider's works during development/customization of solution as per the RFP. The deputed utility engineers shall be involved with the project till its completion.

# Tests, Inspections and Management of the Quality Assurance / Quality Control Program

**Responsibility of Tests and Inspection**

Test and inspections are in the complete purview of the AMI Service Provider and its sub-vendors. It shall be ensured that there are no conflicts in roles played between AMI Service

Provider personnel carrying out tests / inspections, and those assigned responsibilities of quality assurance (QA) and quality control (QC).

The QA/QC organization of the AMI Service Provider shall be an independent administrative and functional structure reporting via its manager to the AMI Service Provider's top management. The QA/QC manager(s) shall have the authority within the delegated areas of responsibility to resolve all matters pertaining to quality when actual quality deviates from that stated in the Work Statement. The personnel performing QA/QC functions shall have well-defined responsibility, authority, and organizational freedom to identify and evaluate quality problems and to initiate, recommend, or provide solutions during all phases of the Contract.

The QA/QC Manager designate for the project shall be the custodian of all inspection and test records/certificates. QA/QC Manager either directly or through its authorized representative shall be responsible for all witness testing, approval of test records and in general, management of the QA/QC program of the project.

The responsibility for inspections and tests is borne by the Inspections and Tests Manager. This team is responsible for creating the various inspection and test procedures and under the general supervision of the QA/QC Manager, conducts the tests.

In the event any imports are required for the purposes of this AMI Service Provider Contract, such imports shall be in accordance with all applicable laws including those issued by Ministry of Power (Order No. No.9/16/2016-Trans-Part(2) dated 18 November 2020; as amended and/ or modified from time to time) for testing of imports including those from prior reference countries.

**In-Process Inspection**

**Type Testing and Data Exchange Protocol Testing**

Type Tests shall be defined as those tests which are to be carried out to prove the design, process of manufacture and general conformity of the product as per IEC standards. The Data Exchange Protocol Tests are defined as those tests which establish compliance with DLMS/COSEM application layer. The Type Testing and the Data Exchange Protocol Testing shall comply with the following general conditions.

a) The QA/QC Manager shall document, within scheduled period as per project plan, copies of test reports and certificates for all the Type Tests that are specified in the specifications and that have previously been performed. These certificates shall apply to items and equipment that are essentially identical to those due to be delivered under the Contract and test procedures and parameter values shall be identical to those specified in this specification. The type tests shall be carried out at nationally/Internationally accredited labs and type test certificates shall not be more than three years old.

b) Type Tests shall be performed for all equipment types for which certification is not provided as required above. If any of the type tests are required to be carried out, the same shall be carried out by the AMI Service Provider.

c) For direct connected Smart Meters, the Type Tests shall follow IEC 62052...

d) For transformer operated Smart Meters, the Type Tests shall follow IEC 62052.

e) For pluggable NIC modules, the type tests shall be carried out with the NIC module integrated in the field device that is meters and DCUs being supplied under the project.

f) Type Tests and Data Exchange Protocol Tests shall be certified or performed by nationally/internationally reputed laboratories using material and equipment data sheets and test procedures that have been developed for the project. The test procedures shall be formatted as in the specifications and shall include a complete list of the applicable reference standards before commencement of test (s).

g) The AMI Service Provider shall prepare a detailed schedule for performing all specified type tests.

h) The AMI Service Provider shall ensure that all type tests can be completed within the time schedule offered in its Technical Proposal.

i) In case of failure during any type test, the AMI Service Provider shall follow the conformance criteria as laid out in corresponding standard (refer serial number c and d above)

j) For direct connected Smart Meters, the Data Exchange Protocol Tests shall follow IEC 62056.

k) For transformer operated Smart Meters, the Data Exchange Protocol Tests shall follow IEC 62056.

l) Documentation for all factory, field, and availability tests that apply to the AMI system shall be provided in accordance with the requirements defined in this section of specification

### 1.2.1 Quality Assurance and Quality Control Program

The QA/QC Manager shall maintain a Quality Assurance/Quality Control (QA/QC) program that provides that equipment, materials and services under this specification whether manufactured, designed or performed within the AMI Service Provider's plant, in the field, or at any sub-AMI Service Provider 's source shall be controlled at all points necessary to assure conformance to contractual requirements.

The program shall provide for prevention and ready detection of discrepancies and for timely and positive corrective action. The QA/QC Manager shall document objective evidence of quality conformance.

Instructions and records for quality assurance shall be controlled and maintained at the system levels. The AMI Service Provider shall outline its QA/QC program plan along with any supporting documents in the Technical Proposal and update the QA/QC program document following site the survey.

A Quality Assurance Program of the AMI Service Provider shall cover but not be limited to the following:

a) The organization structure for the management and implementation of the proposed Quality Assurance Program

b) Documentation control system

c) Qualification data for key personnel

d) The procedure for purchase of materials, parts/components and selection of Sub-AMI Service Provider s' services including vendor analysis, source inspection, incoming raw material inspection, verification of material purchases, etc.

e) System for shop manufacturing including process controls

f) Control of non-conforming items and system for corrective action

g) Control of calibration and testing of measuring and testing equipment

h) Inspection and test procedure for manufacture

i) System for indication and appraisal of inspection status

j) System for quality audits

k) System for authorizing release of manufactured product

l) System for maintenance of records

m) System for handling, storage and delivery

n) A Quality Plan detailing out the specific quality control procedure adopted for controlling the quality characteristics of the product.

The QA/QC Manager shall be required to make available to the Inspection and Testing Team, all the Quality Assurance Documents as stipulated in the Quality Plan at the time of inspection of equipment/materials.

**Inspection and Test**

All materials furnished and all work performed under this Specification shall be inspected and tested. Deliverables shall not be shipped until all required inspections and tests have been completed, all deficiencies have been corrected, and the equipment has been approved for shipment by the QA/QC Manager.

Documents identified in the hardware and software quality assurance plan and procedures shall be inspected to verify that the required quality assurance activities have been performed in the manufacturing process of hardware and software.

Inspections will include visual examination of hardware, enclosure cable dressings, and equipment and cable labelling.

Should any inspections or tests indicate that specific hardware, software or documentation does not meet the Specification requirements, the appropriate items shall be replaced, upgraded, or added by the AMI Service Provider as necessary to correct the noted deficiencies. After correction of a deficiency, all necessary retests shall be performed to verify the effectiveness of the corrective action.

The test shall be considered complete when (a) when all variances have been resolved; (b) all the test records have been filed; (c) QA/QC Manager acknowledges in writing the successful completion of the test.

## Test Plans & Procedures

Test plans shall be provided by the QA/QC Manager, for all tests to ensure that each factory and field test is comprehensive and verifies all the features of the equipment are tested.

The Inspection and Test Manager in AMI Service Provider shall prepare detail testing procedure in line with specification. The procedure shall be modular to the extent possible, which shall facilitate the completion of the testing in the least possible time.

During the development of test plans and test procedures for the system, emphasis shall be placed on testing each conditional logic statement, checking error conditions, and documenting the simulation techniques used. The test plans and test procedures shall be modular to allow individual test segments to be repeated as necessary.

## Test Plans

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

a) Test schedule on a day-by-day basis

b) Responsibilities of test engineer and QA/QC personnel

c) Record-keeping assignments, procedures, and forms

d) Procedures for monitoring, correcting, and retesting variances

e) Procedures for controlling and documenting all changes made to the hardware and software after the start of testing

f) Block diagrams of the hardware test configuration, the external communication channels, and any test or simulation hardware.

**Test Procedures**

The test procedures shall describe the individual tests segments and the steps comprising each segment, particularly the methods and processes to be followed. The test procedures in general shall include the following items:

a) Name of function to be tested;

b) References to the functional, design, user, and any other documents describing the function;

c) List of test segments to be performed and the purpose of each test segment;

d) Set-up conditions for each test segment, including descriptions of the test equipment;

e) Descriptions, listings, and instructions for test software tools and displays if any;

f) Step-by-step descriptions of each test segment, including user actions for each test step;

g) Expected results for each test segment, including pass/fail criteria;

h) Descriptions of the techniques and scenarios to be used to simulate system field inputs and controlled equipment;

i) Copies of any certified test data to be used in lieu of testing.


**Test Records**

The complete record of all factory and field acceptance tests results shall be maintained by the designated QA/QC Manager of AMI Service Provider. The records shall be maintained in a logical form and shall contain all the relevant information. The test reports shall be signed by the inspection & testing engineer and the QA/QC representative witnessing the tests. The records shall be keyed to the test procedures. The following items shall be included in the test records:

a) Reference to appropriate test procedure

b) Date of test

c) Description of any test conditions, input data, or user actions differing from that described in the test procedure

d) Test results for each test segment including a pass/fail indication

e) Identification of AMI Service Provider's test engineer and QA/QC representative.

f) Provision for comments by test engineer and QA/QC representative

g) Copies of any variance reports generated

h) Copies of reports, display copies, and any other hardcopy generated as part of the test.

**Reporting of variances**

Starting from the dry run test period, a variance report shall be prepared by the inspection and testing engineer each time a deviation from the requirements of this Specification is detected in areas such as system functions, design parameters, performance, documentation, test plans, and test procedures. Record of all such variances and their resolution shall be maintained by the QA/QC Manager.

However, at any stage if QA/QC Manager feels that quality of variances calls for suspension of the testing the testing shall be halted till satisfactory resolution of variances, which may involve retesting.

The report shall include a complete description of the variance, including:

a) Sequential identifying number assigned to the variance

b) Date and time the variance was detected

    c) Appropriate references to the test procedures and this Specification

    d) Description of test conditions at the time the variance was detected

    e) Identification of testing and QA/QC representatives

    f) Estimated date and time when variance is expected to be fixed

    g) Description of the corrective actions taken (to be completed as part of the variance resolution process

    h) Dated signature lines for the QA/QC and test representatives to signify reporting and correction of the variance.

Each variance shall be assigned to one of three classes defining the action to be taken to resolve the variance:

a) <u>Class 1</u>:  Testing will immediately stop and the AMI  Service Provider will evaluate and correct the variance before testing is resumed

b) <u>Class 2</u>:  Testing will continue, and the variance will be evaluated and corrected by the AMI Service Provider  at the end of the current session but prior to further testing

c) <u>Class 3</u>:  Testing will continue, and the variance will be evaluated and corrected at a mutually agreed upon time between QA/QC Manager and the Inspection and Testing Manager.

The class shall be assigned by the QA/QC representative.

The QA/QC Manager shall maintain and periodically distribute a variance summary that lists for each variance the report number, a brief description of the variance, its class, and its current status (open or resolved).

All actions taken to correct variances shall be documented on the variance report by the AMI Service Provider. Sufficient information shall be recorded to enable QA/QC representative to determine the need for and extent of retesting, the need for testing interactions of the correlation with any previously tested hardware or software, and the need for updating appropriate documentation. A variance shall be deemed resolved after retesting has been performed satisfactorily and the test engineer and QA/QC representatives have acknowledged correction of the variance on the variance report.

**Test Initiation**

The following conditions must be satisfied before starting any test

a) All test plans and procedures for the test shall be available.

b) All hardware and software engineering design change orders shall be incorporated into the system under test.

c) All relevant documentation including drawings, lists of deliverables, and software functional and design documents, and user manuals shall be available.

d) A complete regeneration of the software under test shall be performed immediately prior to the start of factory testing.

e) All operating system parameters, files, and configuration information shall be saved to archive media so that the AMI systems operating environment can be recreated starting with an un-initialized system. The existence and completeness of this data shall be demonstrable.

f) All database, display, and report definitions shall be saved to archive media so that the databases, displays, and reports can be recreated if necessary.

g) The image backup of all applications of AMI Systems shall be taken on the archive media so that AMI systems software can be regenerated if necessary.

h) A complete dry run of each factory test (excluding the integrated system test) shall be conducted by the AMI Service Provider using the test plans and test procedures.

**Test Completion**

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

a) All variances have been resolved

b) All test records have been documented and issued

c) QA/QC acknowledges, in writing, successful completion of the test.

**Factory Acceptance Test (FAT)**

The factory tests shall be conducted on all the equipment to be supplied under the project. FAT shall include, but not be limited to the following, appropriate to the equipment being tested:

a) Verification of all functional characteristics and requirements specified.

b) Inspection and verification of all construction, wiring, labelling, documentation and completeness of the hardware

Arrangements shall be made to carry out the tests for pluggable NIC modules integrated into three different meter makes, including the make(s) of meter being supplied by the AMI Service Provider. The slot for plugging the NIC modules in the meter shall conform to this specification. The FAT shall be carried out on the meter and/or DCU integrated with the NIC modules. If any on-line communication failover has been agreed between the Utility and the AMI Service Provider, tests shall be carried out to check a seamless failover of communication. The three makes of meters shall be checked with NIC modules for all type of communication technologies selected for the project.

Before the start of factory testing, the QA/QC Manager shall verify that all changes applicable to the equipment have been implemented, type test certificates and Data Exchange Protocol Certificates (as per sampling criteria specified) are available. As a part of the factory tests, unstructured testing shall be performed to enable proper verification of operation of the equipment under conditions not specifically tested in the above structured performance test. All special test facilities used during the structured performance test shall be made available for use during unstructured testing. On the approval of the QA/QC Manager, The Project Manager of the AMI  Service Provider  to inform the schedule of FAT to Utility as soon as finalised, with changes, if any.

**Factory Test Requirements**

a) The database displays and the report formats developed for the central system by the Service Provider shall be demonstrated and verified at the start of factory testing.

b) All Field Device, AMI functions, communication & networking systems as well as performance shall be tested and demonstrated.

c) The AMI Service Provider shall also carry out testing of the standard protocol implementation for successful integration before the FAT starts.

d) All hardware and software associated with AMI Systems shall be staged and completely tested with simulated data at the AMI Service Provider's facility.

e) For smart meters, the FAT shall be governed by the Routine and Acceptance tests as laid out in IEC 62052 and IEC 62058.

f) The Tests and Inspection Manager of the AMI Service Provider is responsible for conducting all factory tests.

g) Each of the factory tests described below (i.e., Routine & Acceptance Test of Smart Meters, the hardware integration test, the functional performance test, and the integrated system test, unstructured tests) shall be carried out under factory test stage.

Sample Routine & Acceptance Tests for Smart Meters

a) These tests for Smart Meters are in addition to the Type Test requirements specified under clause 9.2.1 and the Routine and Acceptance tests that the AMI Service Provider will carry out as a part of their FAT procedure.

b) The sample Routine and Acceptance tests as per IEC 62052 and IEC 62058shall be performed in a third-party NABL accredited laboratory. The Utility shall have the authority of selecting the samples (in accordance with IEC 62052 and IEC 62058) for carrying out the Routine and Acceptance Tests. The AMI Service Provider   shall be obliged to undertake these tests at their own cost. The conformity requirement shall follow IEC 62052 and IEC 62058 as the case may be.

c) The AMI Service Provider   shall be responsible for packing, handing over the material to the respective labs and ensuring transportation of the material directly from the manufacturer's location to the Labs for testing and delivering the material to site after successful test results are obtained. The AMI Service Provider shall be obliged to undertake all expenditures that shall be incurred towards packing, transport, inspection, testing charges etc.

d) The lot wise testing shall be as per following methodology:

  i. Sample Routine & Acceptance Tests shall mandatorily be carried out for the 1$^{st}$ lot through NABL Accredited Lab, before installation commencement. and thereafter the same can be done at discretion of utility on subsequent lots on random basis not exceeding a total of 6 times (i.e. 1 random sample test per 10,000 lot).

  ii. In addition to the above, the utility reserves the right to carry out accuracy tests, in line with the above guidelines, in their own Meter testing Laboratory for each lot. The sample size for such test would be [5%] of the smart meters of each lot.

e) The material clearance for installation / commissioning of the lots under the inspection shall only be issued post successful test results from the labs are provided to the Utility by the AMI Service Provider.

f) **Failure of Inspection/Testing**

  i. In case a meter fails in the test, the whole offered lot would be rejected and complete lot of meters under inspection will be required to be replaced by the AMI Service Provider at its own cost.

  ii. If in subsequent inspection of the new lot, the meter again fails the inspection, then the meter shall be rejected, and vendor/sub-vendor shall also be blacklisted.

**Hardware Integration Test**

The hardware integration test shall confirm that the computer hardware conforms to this Specification and the AMI Service Provider supplied hardware documentation. The hardware integration test shall be performed when the computer hardware has been installed in the AMI Service Provider's factory. The operation of each item shall be verified as an integral part of the system. Applicable hardware diagnostics shall be used to verify that each hardware component is completely operational and assembled into a configuration capable of supporting software integration and factory testing of the system. Equipment expansion capability shall also be verified during the hardware integration test.

**Functional Performance Test**

The functional performance test shall completely verify all features of the AMI Systems hardware and software. This shall mean the suit of application software shall be made to run on the actual CSP infrastructure integrated with the field level hardware components, using selected communication paths. As a minimum, the following items shall be included in the functional performance test:

a) Inspection of all equipment for conformance to drawings/document and satisfactory construction and appearance

b) Testing of the proper functioning of all software, including test cases with normal and exception user-entered inputs and responses

c) Simulation of local error and failure conditions

d) Verification that ultimate expansion requirements are met

e) Verification of data link interfaces with other Central systems

f) Verification of Field Device communication interfaces (with failover if any) and data link interfaces with other central systems. This shall include the tests of three makes of meters with different types of NIC modules.

g) Simulation of Field Device and data link communication errors and channel failures, including incorrect check codes and random channel noise bursts

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

i) Simulation of hardware failures and input power failures to verify the reaction of the system to server and device failure

j) Demonstration of all features of the database, display, and report generators and all other software maintenance features. These shall include but not be limited to functional features like pre-payment calculations, billing determinants, tariff settings, energy audit, generation of NMS reports, data base maintenance functions etc.

k) Demonstration of the software utilities, libraries, and development tools

l) Verification that the computer system meets or exceeds performance requirements

m) Verification of the accuracy of hardware and software documentation via random tests

n) Sample check of meter calibration accuracy and testing of spare parts.

**Integrated System Test**

The integrated system test shall verify the stability of the system hardware and software after the functional performance test has been successfully completed. During the integrated system test, all functions shall run concurrently and all AMI Service Provider supplied equipment shall operate for a continuous 100-hour period. This minimum level of activity may be augmented, by other activities that represent normal day-to-day operation of the system as long as these activities are conducted in accordance with the documentation provided with the system. These other activities may include, but shall not be limited to, database, display, and report modifications, software development activities, configuration changes (including user-commanded server and device failovers), and the execution of any function described in this Specification.

The integrated system test shall ensure that the computer system is free of improper interactions between software and hardware while the system is operating as an integrated unit. In case during the 100-hour period testing, un-commanded functional restart or server or device fail occurs the test shall be extended by 24 hours each time such a failure over occurs. Further the test shall not be conducted with the failed device.

**Unstructured Testing**

Periods of unstructured testing shall be allocated to allow AMI Service Provider to verify proper operation of the systems under conditions not specifically included in the test procedures. Unstructured testing shall be conducted in compliance with the following conditions:

a) A minimum of 25 percent of the actual test period shall be reserved for unstructured test of the system

b) The AMI Service Provider's Tests & Inspection Manager along with the QA/QC representative shall be present during unstructured test periods

c) All simulation software, test cases, and other test facilities used during the structured portions of the factory tests shall be available for use during unstructured testing

d) Unstructured testing shall not begin prior to the start of the functional performance test

e) Unstructured testing shall be allowed at the discretion of QA/QC Manager both at the end of a structured test segment and after completion of the functional performance test.

**Dispatch of Material to Site**

The Material Inspection Clearance Certificate (MICC) for all hardware shall be issued by Utility only after successful completion of FAT as per specification. For this the QA/QC Manager of the AMI Service Provider is obliged to submit a comprehensive FAT clearance report to the Utility. At least 10 Field Devices for each protocol shall relate to each central system and the remaining Field devices shall be simulated in the factory test environment. The data exchange between central systems shall also be simulated in the factory test environment.

All Equipment Suppliers/OEMs to the project shall make use of categorised Interim Inspection Reports (CIP Clearance) from Utility to ship materials to site after completion of FAT. CIP shall be issued by the Utility subject to specific FAT report carried out under the responsibility of the QA/QC Manager. Categorised Interim Inspection Report with the lowest category would mean a complete failure of FAT and hence rejection of material. A category between the lowest and the highest, shall mean pending actionable points of minor nature, but material deemed fit for dispatch to site. The category of CIP shall be authorised by the QA/QC Manager and issued by the Utility. In case where CIP is authorised by the QA/QC Manager with the highest category (with no pending actionable points in FAT), the Utility shall issue a Material Inspection Clearance Certificate (MICC).

**Site Acceptance Test (SAT)**

Once the AMI Service Provider finalizes the SAT schedule, the QA/QC Manager shall invite the Utility to witness the tests as per their convenience.

SAT shall be carried out with Smart Meters/DCUs in lots as these are delivered and passes through the Field Installation and Integration tests. **The first lot to be subjected to SAT shall consist of the complete cloud data centre and its hardware and software components along with supply, installation & integration of a minimum of [5%] Smart Meters/ DCUs (along with its related hardware and software equipment)**. The SAT for remaining meter population shall be staged on monthly basis based on the monthly supply, installation and integration of Smart Meters (along with its related hardware and software equipment).

The AMI Service Provider shall start up and check the performance of the equipment of field locations. All hardware shall be aligned and adjusted, interfaces to all inputs and outputs installed, operation verified, and all test readings recorded in accordance with the AMI Service Provider 's recommended procedures. The SAT shall exhibit generally all functions of the equipment and duplicate factory test. All variances must be corrected prior to the start of the SAT. The list of final tests to be carried out in the field shall be listed in the site-testing document by the AMI Service Provider. Among others, the site testing document shall include the following minimum performance tests (procedure of data collection from the meter may vary):

| Data Type | Performance Requirement |
|---|---|
| **1. Load Profile Data Read**[1] | |
| One-month block load profile for installed meters | From 98% of the meters in 12 hours after the midnight |
| **2. Billing Profile Data Read**[2] | |
| Billing profile data for installed meters | From 98% of the meters in 12 hours after the midnight |
| **3. On-Demand Remote reads of meters** | |
| Collection of 7 days of interval energy data and the current total accumulated energy from a selected individual meter | Within 2 minutes |
| **4. Remote connect / disconnect** | |
| Action to response for individual meter | Less than 3 mins |
| **5. Updating of data on consumer portal/ app** | |
| Updating of individual consumer data on portal/ app after receiving the data in MDM | Action performed for active on portal consumers |

| Data Type | Performance Requirement |
|---|---|
| | within 5 minutes after receiving the data in MDM |
| **6. Ping Response with acknowledgement/ response for selected meters** | |
| For installed meters | Action performed at 98% of meters within [5] minute; and |
| For an individual meter | Action performed within 3 seconds |
| **7. Meter loss and restoration of supply** | |
| Receiving of alert for all affected AMI meters | Alert to be received within 3 minutes for 60% of meters |
| **8. Meter Tamper Alerts** | |
| Receiving of alert for an individual meter | Alert to be received within 3 minutes |
| **9. Power Quality Alerts** | |
| Receiving of alert for an individual meter | Alert to be received within 5 minutes |
| **10. Firmware upgrade with acknowledgement/ response for selected meters** | |
| For installed AMI meters (for a batch of at least 20% of installed base) | Action performed at 99% of meters within [18] hours; and |
| | Action performed at 99.9% of meters within [24] hours |
| **11. Remotely altering settings in meter** | |
| For installed AMI meters (for a batch of at least 20% of installed base) | Action performed at 99% of meters within [8] hours; and |
| | Action performed at 99.9% of meters within [24] hours |
| **12. Remotely read events logs** | |
| For reading the full event log for installed AMI meter | Action performed at 90% of meters within [30] minutes; and |
| | Action performed at 99% of meters within 1 hour; and |
| | Action performed at 99.9% of meters within [6] |

| Data Type | Performance Requirement |
|---|---|
| | hours. |
| **13. VEE processing** | |
| For all installed meters | Action performed in [15] mins |
| **14. Computation of Billing Determinants** | |
| For all installed meters | Action performed in [2] hours |
| **15. Prepaid Recharge** | |
| Payment success to consumer acknowledgement | Within 5 mins |
| Payment success to meter update (From MDM to HES to Meter) | • From 90% of meters within 30 minutes<br>• From 99% of meters within 1 (one) hour |
| **16. Utility User Interface** | |
| Manual data entry of new value appears on screen | Less than 6 secs |
| Acknowledgement of any action request | Within 3 secs |
| Display update rate | 2 secs |
| **17. Disaster Recovery Capability (Refer to Clause 2.7.3.3.9 of this Section for details)** | |
| Recovery Time Objective (RTO) | [4 hours] as agreed |
| Recovery Point Objective (RPO) | [2 hours] as agreed |
| **18. On-Demand Remote reads of meters** | |
| Collection of 7 days interval energy data and the current total accumulated energy from a group of 10% of installed base of meters (configurable) | 95% complete within 2 hrs 100% complete within 4 hrs |

Interim inspection reports shall be generated if the SAT is unsuccessful at any stage and all variances shall have to be corrected and recorded. On successful completion of each lot of SAT a clear SAT Report shall be issued for the benefit of the Utility. These SAT reports shall be signed by both the Inspection and Tests Manager and the QA/QC Manager.

**System Availability Test**

QA/QC Manager will be responsible for oversight of the conduct of the availability test. The test shall consist of normal AMI Systems operations without special test equipment or procedures.

Test records defined in the availability test plan and procedures will be maintained by QA/QC Manager. AMI Service Provider will operate and maintain the system according to procedures described in the AMI Service Provider documentation. QA/QC Manager shall raise incident reports for every incident that is encountered and closed with response time, resolution time and hold times.

AMI systems maintenance on an on-call basis shall be provided by the AMI Service Provider during the availability test period. When on-site maintenance support is needed, qualified AMI Service Provider   personnel shall arrive at the site within maximum four (4) hours of notification and shall keep records of the progress in problem resolution. For availability purposes, this service response time and the associated on-site maintenance time shall be taken into account as defined in sections of "Downtime" and "Hold time".

The AMI Service Provider shall maintain an inventory of spare parts, which may be required to achieve the specified availability. These spares shall be in addition to the mandatory spares. All spare parts used during the availability test shall be drawn from AMI Service Provider's inventory.

**Downtime**

Downtime occurs whenever the criteria for successful operation defined are not satisfied. Downtime shall be measured from the start of diagnostic procedures until full service is restored. In the event of multiple failures, the total elapsed time for repair of all problems (regardless of the number of maintenance personnel available) shall be counted as downtime. For onsite response the delay in response time (more than four hours) shall be added to downtime.

**Hold time**

During the availability test, certain contingencies may occur that are beyond the control of any stake holder. These contingencies may prevent successful operation of the system but are not necessarily valid for the purpose of measuring AMI systems availability. Such periods of unsuccessful operation may be declared "hold time". Specific instances of hold time contingencies are:

a) **Scheduled Shutdown**: During scheduled shutdowns, or if an equipment failure occurs while its backup device is scheduled out-of-service, the resulting system outage shall be hold time, provided that service can be restored according to AMI  Service Provider -specified procedures within 30 minutes.

b) **Power Interruption and Environmental Excursion**: Loss of power or manual shutdown in the event of loss of environmental control shall be considered hold time. If the system is operated during periods of power or environmental conditions beyond those specified, any resultant downtime shall also be considered hold time.

c) **Intermittent Failure**: Periods during which an intermittent, recurring software or hardware failure is experienced will be considered hold time, provided that the AMI Service Provider is engaged in remedial action and normal functions can be restored by AMI  Service Provider    -defined procedures whenever the failure occurs. Instead of accounting for the actual intermittent downtime, one hour of downtime shall be counted for each 24 hours of otherwise successful operation while the problem persists.

d) **Service Response Time:** A maximum four (4) hours of hold time will be allowed for the AMI Service Provider to respond to each call for maintenance support.

e) **Corrected Design Defect**: Hold time may be declared to ensure against similar future occurrences if a failure occurs due to a defect in system design for which the AMI Service Provider defines and implements corrective measures.  In such a case, hold time shall be allowed in increments of 24 hours to allow verification of the corrective action.

**Test Duration and Criteria for Acceptance**

After the elapse of 5 days of cumulative test time, the availability shall be calculated. Should availability fall short of specified percentage as defined, the AMI Service Provider may either (a) Continue the test by moving the starting time of the test forward and continuing the test until the consecutive hours have been accumulated and the specified availability has been achieved subject to maximum of 5 days, Or (b) the AMI  Service Provider  may restart the test for 120 hours.

To establish that all failures have been satisfactorily repaired prior to the end of the availability test, no downtime, intermittent (hold time) failures, or more than one un-commanded fail over shall have occurred within 48 hours of the test's conclusion.

**Criteria for successful operation**

The AMI system shall be designed to meet the system availability as defined below:

| S. No. | System | Minimum System Availability Requirements |
|--------|--------|------------------------------------------|
| 1. | **Smart Meters** | **98.0%** |
| 2. | **DCU/ AP** | **98.0%** |
| 3. | **MDM** | **99.5%** |
| 4. | **HES** | **99.5%** |
| 5. | **NOMC Hardware such as UPS, Router, etc.** | **98.0%** |
| 6. | **Utility and Consumer User Interface** | **99.5%** |

The total operational time shall not include the hold time.

**Operational Go Live**

**Conditions to Be Met for Operational Go Live**

The Operational Go Live of the AMI system shall be considered as completion of the SAT for 5% of Total Smart Meters (along with its related hardware and software equipment) supplied

installed and integrated. AMI SERVICE PROVIDER's obligations for Operational Go Live of the system shall be deemed to be met when the following milestones are achieved:

a) Completion of training obligations pre-Operational Go-Live;

b) Supply, installation & integration of 5% of Smart Meters of the respective lot as per the definition of Go-Live/ UAT specified therein whichever is less (along with its related hardware and software equipment);

c) Successful completion of SAT for the quantity of Smart Meters as mentioned in serial no (b) above;

d) Successful completion of system availability test for 120 (one hundred twenty) hour. This shall be conducted on supplied systems under normal day-to-day operating conditions. The test shall verify the reliability and integrity of the Field devices, Central Systems, Communication & networking systems, database, displays, report, and all communication interfaces.

e) Independent third-party cyber security audit

### Certification of Operational Go Live

Following the successful completion of System Availability Tests the AMI Service Provider has to submit the following documentation to the Utility Project Manager:

a. Utility certification of training obligations pre-Operational Go-Live

b. SAT and resolved variance reports of initial installation phase co-signed by the QA/QC Manager and the Inspection and Test Manager.

c. Availability and resolved incident reports of System Availability Test signed by QA/QC Manager

d. Initial third-party Cyber Security Audit Report

Based on these submittals the utility shall check for the completeness and accuracy of the submittals and issue Operational Go Live certificate to the AMI SERVICE PROVIDER in not more than [3] days from the date of submittal. Commercial operation shall be effective from the date mentioned in this certificate.

# Project Management

Prior to AMI Project Implementation, the AMI SERVICE PROVIDER will prepare and submit a detailed project implementation plan, in consultation with the Utility, to ensure smooth takeover of existing Utility systems and any ongoing services under the scope of the AMI Project.

### Project Implementation Plan would cover the following:

i. Understanding of Utility and its requirement with respect to Project implementation;

ii. Overall system architecture and system philosophy capable of scale-up;

iii. Details of proposed methodology;

iv. Schematic Diagram of Proposed System Configuration

v. Strategy for deployment of feeder-wise smart meters and communication infrastructure

vi. Detailed bill of quantities for materials and services (including any special equipment) necessary to meet the technical specifications, functional & performance requirements

vii. An approach paper documenting the interfaces for integration with existing and future applications based on the information provided by utility

viii. Project team structure;

ix. Line of Credit / Source of funding and supporting documents;

x. Governance framework;

xi. Resource planning and estimation;

xii. Risk planning;

xiii. Quality Assurance/ Quality Control of the Program (including Testing and Inspection);

xiv. Data Privacy Approach

xv. Cyber Security Approach;

xvi. Site Survey result;

xvii. Documents, Data Requirement Sheet, Drawing submission and approval;

xviii. Installation & Field update schedule;

xix. Repair and Maintenance Schedule including details on Spares Management;

xx. Training schedule;

**Key Personnel**

The AMI Service Provider shall appoint at least the following personnel dedicated for the AMI Project

a) **Project Manager:** She / he shall have the authority to make commitments and decisions that are binding on the AMI Service Provider. Utility will designate a Nodal officer to coordinate all project activities. All communications between the Utility and the AMI Service Provider shall be coordinated through the project manager and nodal officer. The project manager should be an expert in AMI Implementation including metering and related aspects, installation and management of Smart Meters, communication network, last mile connectivity, HES and MDM. The project managers shall be responsible for all communications between other members of the project staffs including sub-AMI Service Provider s, if any.

b) **System Integration Expert:** An expert in System Integration covering application software, hardware and network installation, integration design and ability to manage multiple partners with different skill sets in different technology domains.

c) **Cyber Security Expert:** An expert in cyber security related aspects covering planning and implementing high level system security requirements, managing data privacy and confidentiality, information flow through adequate authorizations, threat modelling and security testing.

d) **Communication Protocol Expert:** An expert in communication protocols and in implementing applications using different communication technologies and ensuring communication inter-operability across applications/functionalities.

The project manager shall be responsible for bringing in the Cyber Security expert and Communication Protocols expert at the appropriate stage in the project as and when required.

**Progress Report**

A progress report shall be prepared by the AMI Service Provider for each month against the activities listed in the project schedule. The report shall be made available to Utility on a monthly basis on a mutually agreed schedule, e.g., the 5th day of each month. The progress report shall include all the completed, ongoing and scheduled activities and transmittals issued and received for the month. The progress report will also highlight the risks to the project and plan for risk mitigation.

**Transmittals**

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

**Review Meeting**

Progress meetings shall be scheduled by the Utility and attended by the Service Provider each reporting period to review progress of the project. Progress meetings shall be used to review the progress report, written correspondence exchanged since the last meeting, and open action items. The review meeting will also be used to discuss upcoming milestones, support needed from the Utility, risk identified by the Program team, risk mitigation strategies and to make decisions for path forward.
The AMI Service Provider shall also attend technical meetings as and when required by the Utility to discuss technical aspects of the project and to review Utility comments on documents. When appropriate, these technical meetings shall be conducted as extensions to the progress meetings.

**Document Review and Approval Rights**

To ensure that the proposed systems conform to the specific provisions and general intent of the Specification, the AMI Service Provider shall submit documentation describing the systems to the Utility for review and approval.
The Utility will respond with written comments to the AMI Service Provider within Fifteen (15) calendar days after receipt of the documents. Documents requiring correction must be resubmitted by the AMI Service Provider to the Utility within fifteen (15) calendar days. The Utility will respond to resubmitted documents within seven (7) calendar days after receipt of the document. No Project Implementation Schedule relief is to be implied for documents requiring correction and resubmission to the Utility.
The Utility shall have the right to require the AMI Service Provider to make any necessary documentation changes at no additional cost to the Utility to achieve conformance with the Specification.
To help the Utility manage the review and approval of documents during any given period, the AMI Service Provider shall stagger the release of documents over the time allocated in the project

schedule. The number and size of documents shall be factored into the document release schedule.

# Document Requirements

List of documents to be provided by the AMISP to the Utility over the entire Contract period has been provided below. The timelines for submission along with requirement of Utility approval (if required) have also been provided herewith:

| S. No. | Documentation to be submitted | Frequency | Purpose[3] |
|---|---|---|---|
| A | **Pre-Operational Go-Live Phase (from the date of execution of the Contract till the date of achievement of the Operational Go-Live of the AMI system)** | | |
| 1 | A checklist of all documents on which approvals from utility or other agencies may be required; | Once | I |
| 2 | Consumer engagement plan; | Once | I |
| 3 | Detailed Project Implementation Plan including verification of all integrations with external systems as mentioned in this Contract and delineated in the approach paper created for the purpose | Once | A |
| 4 | Exit Management Plan | Once | A |
| 5 | Document/ drawings to indicate the following:<br>i. Tentative location of devices/equipment for setting up communication network with power plan;<br>ii. Confirmation of adequacy of space and AC power supply requirements.<br>iii. Additional items required for interconnection with the existing/owner provided equipment/facilities;<br>iv. Requirement of modification to existing earthing arrangement of NOMC and locations where communication equipment / devices etc. are to be installed, if any. | Once | I |
| 6 | As-Built Drawings | Updated | I |
| 7 | Quality Assurance Plan including the test plans for each stage of Testing. | Once | A |
| 8 | Type test reports, Guaranteed Technical Parameters of components and associated document as per Clause 9 of this section | Once | I |

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**I**: Informational, no approval required from Utility, **A**: Approval required from Utility based on signed documents submitted by AMI Service Provider ,

| 9 | Data Exchange Protocol Test Certificate [one per one lakh] smart meters | Once | I |
|---|---|---|---|
| 10 | Consumer indexing as per the implemented AMI system | Updated | I |
| 11 | Notice to Utility to witness Factory Acceptance Test | Periodic | I |
| 12 | Factory Acceptance Test Reports with category if any | Periodic | I |
| 13 | Notice to Utility to witness Field Installation and Integration Test | Once | I |
| 14 | Field Installation and Integration Test Reports | Once | I |
| 15 | Notice to Utility to witness Site Acceptance Tests | Periodic | I |
| 16 | Site Acceptance Test Reports | Periodic | I |
| 17 | Progress report briefing the status of installation of meters and key challenges faced if any | Monthly | I |
| 18 | Notice to Utility to witness System Availability Test | Once | I |
| 19 | System Availability Test | Once | I |
| 20 | Certification for Operational Go Live with following documentation:<br>i. SAT & resolved Variance Reports<br>ii. Availability & resolved incident Reports<br>iii. Completion of Training certificate<br>iv. Third party Cyber Security Audit<br>v. Document detailing security algorithm and security key generation method | Once | A |
| **B** | **Post-Operational Go-Live Phase (after the Operational Go-Live of the AMI system till the end of Contract Period)** | | |
| 1 | Monthly progress report briefing the status of installation of meters and key challenges faced if any | Monthly | I |
| 2 | Reports as mentioned in this Contract which includes but not limited to the following:<br>i. Service Level Agreement (SLA) performance report;<br>ii. Monthly progress report including problems that arise with the installed AMI system (if any) including any cyber security related issues and corrective action taken by AMI Service Provider for the same. | Monthly | A |
| | iii. Reports mentioned in Clause 6 of the Section 6; | Monthly | I |

|   | iv. Cyber Security Audit | Yearly | I |
|---|---|---|---|
|   | v. Data Privacy Audit report; | Yearly | I |
| 3 | Change Requests / Change Notes | Periodic | A |
| 4 | Change Orders | Yearly | A |
| 5 | Operation and maintenance manual | Updated | I |
| 6 | Exit Management Plan | Updated | A |

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## Specification for IT Infrastructure

The system shall be designed as per the technical parameters defined in this specification and as specified in this Annexure.

The AMI system (MDM, HES, NMS, etc.) shall be suitably sized based on expansion requirements mentioned in this RFP.

AMI Service Provider should offer auto-scaling of the compute resources based on the defined threshold of resource utilization. There should be a minimum and maximum limit defined for auto-scaling for a workload.

This memory utilization includes the memory used for storage of data (including expansion requirement defined in above para) for the defined duration as specified in the Technical Specification. The system architecture and the network design shall have the ability to handle the growth with respect to functions, and user as defined.

## Design Consideration for Proposed Solution

NEA is under process of upgrading its existing Data Center into a full-fledged facility, it is also deploying the required IT Infrastructure and computation capacity at Data Center for implementation and roll out of AMI System. The upcoming AMI Service Provider should study and evaluate the existing Data Center facilities and shall deploy the necessary hardware and software systems to meet the performance, scalability, business continuity, SLA etc. requirements for 10,80,000 No's of Smart Meters at both Data Center (DC) and Disaster Recovery Center (DRC). Details of NEA data Centre are available under RFP (Invitation for Bids No.: PMD/EGMP/DCC–077/78 - 01) published by NEA dated 10 Aug 2020 for "Design, Supply, Installation and Commissioning of Distribution Command and Control Center". The bidder needs to deploy their AMI solution in this NEA data centre in other words the complete AMI solution of bidder will be hosted in NEA data centre. Hence, they need to study in detail the data centre set up and need to propose their solution accordingly and prepare the financial proposal for rest of the IT requirements.

The design considerations for the deployment of proposed IT Infrastructure at the Data Center and Disaster Recovery Center of NEA.

It is to be emphasized that, NEA is looking to have a holistic AMI system implementation and not just the supply of hardware and software. The mentioned Bill of Material (BOM) indicated in the Bid Documents are minimum requirements. The SIs are expected to focus on the objectives of the Project and should consider both performance and scalability along with SLAs of this project and formulate their solution offering in a manner that enables achieving those objectives both in letter as well as in spirit.

SI shall provide system integration services along with supply, installation and commissioning of the required hardware, software etc. at the NEA Data Centre and Disaster Recovery Centre to deploy the Advance Metering Infrastructure including the applications and integrate with both Legacy, Internal and external agencies as specified in the functional scope. SI's scope would include procurement of hardware and relevant software licenses, additional licenses for existing

AMI System their installation and commissioning at NEA's DC and DRC. The following services will be made available to the SI at the NEA Data Centre by NEA:

- Space for Racks
- Power and Cooling
- UPS, DG set power backup
- Internet Connectivity at DC.
- Fire prevention
- Physical security surveillance
- Network Operation Centre
- DC facility maintenance and support

SIs are required to visit the NEA's Data Centre Site to understand the deployment scenario along with Physical, Civil Electrical & Cooling Solutions available to them for the proposed services and understand key requirements and develop the required solution w.r.t the functional requirements, configuration and customization specific to NEA.

SIs are required to consider the proposed services and must consider the key requirements of NEA and develop the required solution w.r.t the functional requirements, configuration and customization specific to NEA and therefore SIs would need to develop interfaces to integrate with NEA's existing legacy systems, Phase 1st AMI Solution including and specifically the existing Billing module/system being used at NEA.

The proposed solution must have highest degree of interoperability and the solution components should be standard based and adopt an open approach rather than support a specific technology or vendor. The Phase 2nd AMI Solution stack should be interoperable with Legacy/Smart metering initiative applications of NEA.

SI shall be responsible for supply and installation of necessary hardware, software and supporting system for successfully running the AMI system operations for scope of work at Data Center and Disaster Recovery Centers.

SI shall supply, install, commission, and maintain the additional hardware and software systems for AMI Solution stack including supporting system and services at Data Center (DC) and Disaster Recovery (DR).

Shall provide business continuity services from Disaster Recovery site, in case the primary site becomes unavailable.

NEA Shall Provide space and location of Data Center and Disaster recovery Site post award of the contract.

**Service Oriented Architecture (SOA)**

AMI solution components must follow SOA principles to provide specific services using well defined interfaces. Identify opportunities for cross-functional components or subsystems and implement them in such a way that there is an opportunity for reuse. This defines integration architectures based on the concept of a service and becomes relevant especially when there are multiple applications in an enterprise and point-to-point integration between them involves complexity.

**Integration Support**

NEA envisage AMI System as a system API driven architecture at the core of it. AMI system features can be accessed via any user interface (internal or 3rd party applications) which shall work on top of these APIs. Adoption of open API, open standards are of paramount importance for the NEA AMI system. Data access must be always through APIs, no application will access data directly from the storage layer or data access layer. For every internal data access also (access between various modules) there will be APIs and no direct access will be there. This will ensure the AMI system is scalable and secure. Openness must be supported by open standards and vendor neutral APIs and interfaces for components.

The integration middleware should be based on Service Oriented Architecture (SOA) and other forms of Application Program Interfaces (API) and use publish / subscribe mechanism.

The integration mechanism adopted must have minimal impact on the existing systems

The access to data will only be through business rules i.e. the applications will not access data directly without going through APIs managed by business rules/validation/workflow.

The integration middleware/interface must validate the data to be integrated

It must maintain integration logs that confirm the success or otherwise of the interface, complete with control totals

**Data Migration**

The successful SI shall migrate and synchronize the data from existing MBC systems, Phase 1st AMI System, GIS solutions with upcoming Phase 2nd AMI System as per requirement of the NEA. It shall migrate, cleansed, rationalized, transformed (if required) and reconciled the master data of NEA Consumer and MBC database. All open transactions at the time of migration must also be migrated and synchronized. It is the responsibility of the AMI Implementing Partner to ensure that always the field data (Consumer, meters, etc.) shall be in sync across all the systems both legacy and new solutions.

**Ease of Management**

The solution must factor capabilities and features that allows for ease of management and trouble-shooting. The underlying technology needs to be user friendly. By having easy to use principle, training can be kept to a minimum thereby aiding IT change management and the risk of using a system improperly can be minimized. The solution should provide support:

Support maintenance, enhancement and refactoring the solution without architectural changes

Administering the solution with minimal user intervention and using role-based administration, well defined user interfaces and access policies.

Implementation of Changes should be done quickly without even if architectural / DB Schema changes are required.

Ability to log and report at a sub-system level state, health of the solution. It shall also log different events encountered by the subsystem.

**N-Tier / Modular Design**

The application user interface, logic, data must be separate. The logical design of components, subsystems, application systems and databases will be ideally partitioned. These partitions shall have well-defined interfaces established. Logical boundaries are needed to separate components from each other. Modular design is more adaptive to changes in internal logic, platforms, and structures. It is easier to support, is more scalable and supports interoperability.

**Scalability**

Scalability is the most important aspect of AMI solution. It is envisaged that the users and geographic locations may increase over in coming years with phase wise roll out of AMI Solution. The system architecture and the network design should have the ability to handle the growth with respect to functions, users, load, and geographic sites. Also, applications must evolve to support new business requirements and make use of new technologies. SI must factor both vertical and horizontal scalability in the design and deployment of AMI solution.

**High Availability, Failover, and Load Balancing at DC and DRC**

The solution shall be hosted in at Data Center & Disaster Recovery sites or at a location approved by NEA. The solution tier for critical applications should consist minimum of two nodes clustered on a fail-over configuration for the critical components like Web, application & database servers at the Data Center site. Proposed components shall have adequate redundancies with no single point of failure for the solution at the Data Center site. On failure of the primary application server, the 'failover' server shall take over the processing. Similarly, on failure of a database server, the other server shall continue seamlessly, thus providing the desired availability.

All network & security equipment / devices shall have the capability to failover to a redundant or secondary unit upon failure of the primary unit. Likewise, the load on the primary unit shall be shared with a secondary unit upon the primary unit reaching its capacity.

**Business Continuity & Disaster Recovery**

In case, if primary site / DC fails, the business should continue from DR site. Connectivity between primary site and DR site should be redundant. In case of Failures of Storage at DC, DR Backups shall be used to restore the Database from the last backup taken. This shall be defined in Backup policy during project execution. Service Provider should propose the backup strategy and any other additional BoM if needed to meet this requirement.

Service Provider should propose a solution where the Recovery Point Objective (RPO) should not be more than 1 hour and Recovery Time Objective (RTO) should not be more than 240 minutes.

SIs are expected to keep the above issues in mind and propose technically best alternative to ensure that the system is available for the users in all times by conceptualizing various scenarios and explaining how their solution addresses all the possible scenarios. While the Bill of material proposed is the bare minimum required to be supplied, SI should propose additional solution components as may be required to meet the above objectives.

**Zoned Deployment**

The IT Infrastructure will have multiple security layers to secure the infrastructure from threats. The proposed deployment has different security zones as briefed below and all zones should have separate firewall in addition to the external (Perimeter security appliances). The firewall policies should be configured based on zone-based requirements.

Militarized security Zone for Production Servers (Database and Application Server Farm **(MZ):**

Militarize Zone (MZ) will secure host all critical application, Data Base server, Storage etc. The Zone shall not be accessible from Internet directly. All user traffic will to enter in this security

zone after firewall only. The proposed solution will have provision of dedicated Internal Firewall to secure the critical production (Data base and Application) environment.

**Demilitarized Security Zone (DMZ) Web server Farm Zone:**
This security zone will host all servers that can be accessed from external users after authentication and traffic filtering. This zone shall host the Web servers, Access control & sign on servers, Antivirus Server etc.

**Test, development & Staging zone (TDSZ):**
This zone will host all servers required for test and development for applications. This zone will have limited access and it will not have any direct access to Production zone (PZ) and the activity shall be monitored.

**IT Infra Management Zone:**
The technical manpower proposed by Service Provider for DC & DR infrastructure will use this facility and will be able to access the infrastructure from this zone only. This can be based at NEA Head Quarters or DC/ DR site. Traffic for this zone will be virtually segregated / zoned by firewall.

**Information Security: Log monitoring**
All Servers / sub systems / network devices / appliances as proposed by Service Provider should have capability and throw logs to the log server. The Logs and events generated by network & hardware component / devices of the system shall be monitored. Service Provider must provide a Security information and event management (SIEM) solution for the same which should be capable to provide various security alerts, events, logs generated from various IT infrastructure (Hardware/Software) components. Service Provider would need to ensure the IT security compliance and therefore monitor the threats/logs generated by various equipment's / sub systems.

**Backup and Recovery**
Data is an asset, just as personnel, physical resources, and financial resources are assets. Data and information are resources that are extremely valuable for the organization; hence data management processes must be in place to maintain the data. Service Provider needs to prepare a backup policy which shall be approved by NEA. Service Provider would be required to design detailed backup and recovery policies which shall be implemented at the time of deployment. The responsibility of taking backups and testing the backups as per the backup policy shall be of Service Provider for the entire project period. Service Provider shall ensure that the data is replicated at the backup site at DR Site. Service Provider shall be responsible for safe & secure storage of complete data.

**Policy & Documentation**
SIs will have to develop, document, and implement the following:
- Data Backup, Archival & Retention Policy
- Security Policy

**Business Continuity & Disaster Recovery Policy**

All the policy and procedure which will ensure availability & security at all times, these policies have to be updated in every six months (twice a year) or as per requirements of NEA. Service Provider  MUST design and implement the policy (with NEA inputs) in compliance to the ISO standards (such as Information security ISO 27001). Design of Information Security Policy should necessarily include but not limited to the following policies to ensure IT security in NEA:

- IT Risk Management Policy
- Information Classification Policy
- Access Control Policy
- User ID and Password Management Policy
- Internet Access Policy
- Asset Management Policy
- Incident Management Policy
- E-mail Security Policy

**Virtualization**

SIs should  use virtualized deployment and all the Servers should be virtualized from the day 1. SI is requested to propose a deployment strategy keep in mind both logical and physical segregation of Application, Database & other services without any overlap and compromising design parameters like High Availability etc.

Virtualization Design Considerations

SI should separate and Isolate Management and De-Militarized network zones.

SI should utilize partition trust zones as: Core application zone, Public Interface services & Database Zone.

SI must use Harden the virtual Infrastructure according to security best practices for virtualization and should secure virtual machines like physical servers. (such as Antivirus etc.)

SI should strictly control administrative access (such as Use roles-based access control to limit administrative capabilities) and enforce separation of duties.

SI should configure the VM's with sufficient compute capability, memory & I/O requirement.

**Scalability**

Scalability is the most important aspect of the project as the solution is going to be deployed at 8 DCS of the Kathmandu valley which shall be scaled up to cover entire Nepal. Therefore, all the deployment of application should be considered for entire Nepal for the entire project period. SI must factor both vertical & horizontal scalability in the design and deployment of application.

**Sizing of Hardware**

Sizing is the most important aspect of the project in this phase the user base is 9375K but this shall be scaled up to cover entire Nepal. SI must size the applications for entire Nepal for the entire project period. SI must propose hardware sizing based on their sizing of peak load considering 40% concurrency they must highlight all the assumptions taken in consideration for sizing.

**Utilization of Hardware**

SI should design & Size the hardware to cover entire Nepal for the entire project period. SI must propose hardware sizing considering that Hardware/Virtual Machine utilization should never cross 70% at the peak load during the entire project period.

**Technical Obsolescence**

SI should not provide any solution in AMI solution stack which is at the verge of sun set and becoming obsolete. The AMI systems including ancillary stack, which are at a risk of technical obsolescence over the next few years and over the operating life of the system should be identified and reported. The compatibility between the various elements of the system need to be considered and mitigation options, not be limited to periodic update from OEM/system supplier/ SI, shall be indicated in detail.

**Licensing**

SI shall procure and supply the licensing of required AMI system software including Meter Data Management System and Head End System.

All the licenses shall be procured/supplied in the name of "Nepal Electricity Authority". All the licenses shall be owned by NEA during the contract and even after the end of "Contract Period".

SI shall provide license in compliance to the BOM and BOQ requirements/Number of Consumers /Number of Meters for MDM and Head End System.

The purchaser shall be at liberty to deploy the solution anywhere within NEA.

The source code of the customized part of the application software will remain the exclusive property of NEA, during the contract period even after termination or expiry of the contract.

Enterprise wide shall mean Complete NEA with geographical coverage over Kathmandu.

NEA shall have the rights to use all this software to serve consumers within the organization.

**IT Equipment Specifications**

Instructions for filling the annexure documents

It is mandatory to fill up all sheets provided under this Annexure

SI should fill up the specification sheets in the given format using MS-Excel.

SI should ensure that none of the listed parameters are modified, deleted and no additional parameter is added. (Remarks, if any, should be indicated separately in the Remarks column)

In case, the SI is proposing any additional product category that is not listed in this section, he may use additional sheets.

In case, the software proposed by the SI has multiple modules/components that are priced and sold separately, the SI should use additional sheets for each such module/component and include the licensing policy and number of licenses proposed for the same in the respective sheets. The same should also be reflected in the Commercial Bid format as new line items with the above said references.

Wherever minimum requirements are specified, it is mandatory to indicate with a YES or NO, whether the solution being offered complies with the minimum requirements stated. In case of non-compliance, details/remarks must be provided.

It is mandatory to fill up the "SI's Response" column against all the listed parameters / features.

Incomplete/ missing information or information not adhering to the prescribed format may not be considered during evaluation of bid and/or for award of marks.

SI is advised not to make any changes to any information in the functional requirements. For example, insert a row or delete a row or modify any other information like change the functionality required, etc.  In case the SI modifies any information, the response would be rejected.

The requirements provided are minimum value. It is the responsibility of the SI to provide the optimum size of the equipment and its component to ensure trouble-free and smooth operation after proper study of the system requirement. The SI is required to provide necessary design parameter to prove the requirement.

The server shall be suitable to accommodate the functioning of the distribution control centre which will control the distribution system and equipment, which is proposed to be developed in the future (within few years).

**Technical Requirements Specifications -Hyperconverged Infrastructure, Software Defined Network and Cloud Orchestrator.**

| Technical Specifications for DC and DR Virtualization | |
|---|---|
| Requirements | Compliance (YES/NO) |
| **Hardware Specifications** | |
| Proposed Infrastructure Solution should come with fully redundant field replaceable components. | |
| Proposed Infrastructure Solution should have independent hot swappable components which can be replaced and serviced without having the need to power down. | |
| Proposed Infrastructure Solution should include x86 Nodes of following specifications. | |
| **Computing and RAM Pool** | |
| Total useable cores: Database Compute node with 120 core, 3.0 GHz and Web, Application and Other Compute 500 Cores, 2.1GHz Processor with 35 Mb Cache. Latest Generation processor across Cluster | |
| Total RAM: Database Compute with 24 GB per CPU Core and Web, Application and Other Compute with 8 GB per CPU Core DDR4 3200 MHz across Cluster | |
| **Storage Pool** | |
| Boot Device for hypervisor : Mirrored 200GB or higher Flash Modules per Node. Each flash module should be no less than 200GB. | |
| Storage: 500 TB Useable across Cluster (20% should be SSD) Note: Should be hot swappable and field replaceable. | |
| **Power Supplies and RU** | |
| Redundant power supplies and Fans to be proposed. | |
| **Network Interface** | |
| Network Interface: 4*10G SFP+ per node | |
| **Warranty and Maintenance** | |
| The bidder should provide comprehensive warranty till end of contract period with 24 x 7 x 365 for all equipment and software included in the proposed solution. | |

| Hyper Converged Solution Requirements | |
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| The proposed solution should come with preinstalled various software including SDS with management and associated hypervisor. It should include all hardware and software necessary to ensure high availability mode of operation. The proposed solution should have Single Management Console to manage integrated Compute, Storage and Hypervisor. The solution must come with bundle/customer license, which must be clearly mentioned in OEM's license portal. The platform and environment should be customizable as per the requirement of User. The proposed HCI solution should be able to leverage SSD not only for caching but for capacity also to optimized read IO's and there should not be any limitation on SSD overall caching on software defined storage. The proposed solution should be completely software defined and should not rely on any hardware RAID controller. | |
| The HCI solution should include Hypervisor License and should support at least one of the industry leading hypervisors. | |
| Dashboard to manage and provision virtual machines, network, storage, monitor performance and manage events & alerts. It should also contain a dashboard for monitoring & generate reports. The solution should provide a log analytical tool which will show all the logs available in one single management console and a single location to collect, store, and analyze unstructured data from OS, apps, storage, network devices, etc. to make troubleshooting easier. Solution provide OEM should be able to provide the Virtualization software for both End Point and Server. | |
| Technology must be software defined and the solution should provide enterprise-class storage services using latest x86 server infrastructures without dependence on a separate Storage Area Network & associated component such as SAN Switches & HBAs. The solution should have data locality. | |
| The solution must be able to survive single node failures and it should in no way affect/degrade the production services & usable resources to the end user application. Solution must support all the mentioned industry Leading protocols NFS, iSCSI & SMB. | |
| Solution should include an application and infrastructure performance management tool quoted as part of the solution to improve operations and provide deep infrastructure performance insight. | |
| Proposed solution should cater virtualized core based licensing for products like (but not limited to) Oracle, MSSQL and etc. The solution must natively support RDMA for better performance. | |
| It should be possible to use different storage policies on VMs and container level with Storage QoS. | |
| Solution should support live migration of running virtual machines from one physical node to another with zero downtime and continuous service availability. | |

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| The solution should provide enterprise data services such as de- duplication, encryption & compression without dependence on any proprietary hardware. This should be delivered in both all flash or as hybrid solution. These functionalities should be part of the proposed solution and licensed. The proposed HCI solution should be able to create multiple logical unit (LUN's) for storage with multiple policy for deduplication and compression across storage logical unit. The Proposed HCI solution should support Erasure Coding for archival data storage. | |
| The proposed solution must support connectivity (Storage extension) to 3rd party bare metal servers (for optimized DB licensing on physical servers) to storage cluster & use the cluster capacity like( but not limited to) iSCSI, NFS target. | |
| The proposed solution should support Hybrid only or All Flash only Nodes in the same cluster. Proposed SSD should be used for both storing Data and Caching. (If OEM uses SSD/NVMe dedicatedly for caching then additional SSD should be proposed). It should be possible to Pin IOPS hungry VMs on SSD only | |
| Proposed solution should have inbuilt Data at Rest Encryption (DARE) and should also include Key Management Solution. (OEM should not depend upon 3rd party key management solution or specific hardware to achieve the same) | |
| The solution should support to connect external storage devices (like NAS, SAN etc.) and should be useable as part of the Solution, for the purpose of Backup. There should not be any hardware vendor locking while connecting the external storage/s and this can be accessed over IP (No proprietary protocol should be used). | |
| **Scalability** | |
| The Proposed Solution shall support minimum 32 nodes in a same cluster without any federation. | |
| The solution should be able to scale by support of adding additional nodes to the cluster at a later point of time to handle compute, Memory & Storage requirements. Solution should support cluster expansion with zero down time. The proposed solution should support hybrid or all flash nodes in same cluster for future scalability. HCI solution must have capability to support HCI nodes with different models, different CPU Generations & Memory, Disks configurations in the same cluster without any impact on enterprise class storage services/functionalities. | |
| configurations in the same cluster without any impact on enterprise- class storage services/functionalities | |
| Data compression, deduplication, erasure coding techniques should be available with licenses (if applicable) in the Software Defined Storage (SDS) layer for use without additional cost. | |
| **Data Protection** | |

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| Ability to provide Replication of Virtual machine backup locally and in Disaster Recovery site. (VM level Mirroring) to protect selected VM's. If licensing module is there, bidder should provide licensing details. Should come with solution and should implement from Day 1 of operation. | |
| Solution should be able to take App and database consistent snapshot and should be able to schedule the same. | |
| Shall be able to restore VM from the backup. | |
| **Remote Replication** | |
| HCI solution should support file level recovery of user's data from VM's without Storage/VM's admin involvement | |
| HCI solution should support VM's snapshot at storage level, it should not impact guest OS performance during snapshot. Each VM should provide minimum 30 VM snapshots. | |
| HCI solution should be able to take VM's snapshot/Storage snapshot at any time irrespective of VM's state (Power ON/Power OFF/Suspended) with retention policy | |
| HCI solution should support crash consistent and application consistent backup within cluster or for the proposed HCI Solution. | |
| HCI solution should support VM's backup on leading cloud providers, AWS, GCP, Azure | |
| HCI solution must support two copies of data across cluster and should have capability for supporting three copies for critical data and it should be available on workload level. | |
| HCI solution should support data replication across sites with customized RPO i.e. 0 mins/5 mins/15 mins and grouping of Virtual machine as per application architecture | |
| HCI solution should support WAN Bandwidth optimizer along with defined schedule across two sites and only increment data should be replicated post one time data sync | |
| HCI solution should have license for three way DR for active-active configuration with near sync, async replication with defined RPO, some of VM's are working from Primary (Site-A) and their DR at DR sites (Site-B) and Some of the VM's are working from Site-B and their DR's is at Site-A. It should have feature to change VM IP's on the fly without manual intervention in case the DR site has different subnet from DC Site. The Replication software should provide DR Orchestration and should be able to do VM power up sequencing. License should be provided for unlimited VMs. | |
| **Hypervisor** | |
| The solution shall provide a purpose-built hypervisor with minimal footprint that installs directly on the 64 bit bare metal x86 dual socket servers | |
| Hypervisor should support container and openstack integration for cloud native application | |

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| Virtualization Manager should have integrated Physical Host/ Node and Virtual Machine performance monitoring with high availability construct. No single point of failure for Virtualization Manager | |
| Single view of all virtual machines, allow Monitoring of system availability and performance and automated notifications with alerts. Monitor, analyze virtual machines, server utilization availability with detailed performance graphs and greater visibility into object relationships | |
| High Availability capabilities for the VMs in the sense if in case one server fails all the Virtual machines running on that server shall be able to migrate to another physical server / node running same virtualization software | |
| Ability to thin provision disks to avoid allocating all storage space upfront. Full monitoring capabilities & alerts to prevent from accidentally running out of physical storage space should be there | |
| Hypervisor should support virtualization guest tools inside guest for optimized performance for video/network/performance and disk reclaim options from guest OS's | |
| Hypervisor should support OVA/OVF image import and export | |
| Hypervisor must have capability for OS Catalogue/template and OS provisioning with role based access to virtual machine | |
| Capability for creating Virtual machine templates to provision new servers and also allow taking point in time snapshots of the virtual machines to be able to revert back to an older state if required | |
| Hypervisor should provide integrated snapshot-based backup, schedule backup/restore and configure multiple copies of backup on periodic interval either inbuilt with hypervisor or 3rd party solution. | |
| Proposed hypervisor should support standard features like non- disruptive migration of workload across hosts, High Availability and Distributed resource scheduling during resource constrain | |
| Hypervisor shall provide automated live migration for initial placement and balancing of available resources with the rules to define affinity and / or anti-affinity of workloads | |
| Hypervisor solution must allow seamless migration across different CPUs with Enhanced vMotion Compatibility mode per-VM during migrations across hosts in a clusters and during power cycles | |
| Hypervisor shall provide the ability to hot add CPU and memory, hot-plug disks and NICs ( provided the same is supported by guest OS ) | |
| Hypervisor should provide ability to grant / ensure resources to virtual machines as they need for hosting critical workloads. Also, the initial placement of workloads should consider CPU, Memory and Storage contentions / hotspots | |

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| Hypervisor shall provide zero downtime host patching with maintenance mode to move running workloads to other hosts on the platform with a consistent audit trail of the patching process | |
| Hypervisor should support UEFI bios for supported virtual guests OS | |
| Virtualization Manager should automatically check cluster components, hosts, storage, network, hardware and cause of performance issue on configurable schedule with results on designated email. | |
| Virtualization Manager should be able to identify out of the box top 10 VM's basis on their high resource utilization (CPU/Mem/Storage/Network) on single dashboard | |
| Virtualization Manager must support Directory based/OpenLDAP and SAML based authorization for management | |
| Virtualization manager should keep at least 90 days historical performance data for VM's/Storage and partnering host | |
| Hypervisor/management must should be able to disable SSH based login to cluster for security and should have support for ssh key based login | |
| Hypervisor and Management must support SNMP version 3 and SMTP for proactive alerting and email configuration | |
| Hypervisor must provide centralized interface from which virtual machine access switching for the entire virtual datacentre can be configured , monitored and administered | |
| The Virtualization manager should provide a virtual switch which can span across a virtual datacentre and multiple hosts should be able to connect to it. This in turn will simplify and enhance virtual-machine networking in virtualized environments and enables those environments to use third-party distributed virtual switches | |
| Virtualization Manager should provide feature which can perform quick, as-needed deployment of additional virtualized hosts. When the service is running, it can push out update images, eliminating patching and update without impacting production | |
| 3rd party support for endpoint security to secure the virtual machines with offloaded antivirus, antimalware, firewall and hips solutions | |
| Hypervisor should support Rest API and Command line management along with GUI interface. | |
| Required Hypervisor License and Hypervisor Management should be included into the solution | |
| **HCI Management** | |
| HCI solution should support automated and zero touch upgrades for hardware/storage/hypervisor with no major impact on production. | |

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| HCI solution should provide all key operation management and performance management from a single console for Hardware/Storage/Hypervisor and VM 's management using HTML 5 internet browser | |
| HCI solution management pane should integrated with Active Directory /LDAP | |
| HCI solution must support monitoring via SNMPv3 and email alerting via SMTP | |
| HCI solution should have analytics on capacity behaviour and should have capability of showing all under and over utilized VM's with their right sizing information after current VM's usages | |
| HCI solution should be capable of creating custom dashboard with reporting as per customer ease and requirements, solution should be able to scan/search objects with advanced search option for faster access to require information for troubleshooting | |
| HCI solution should have capability for finding object anomalies from standard behaviours and report this before major bottleneck for solution. | |
| HCI solution should have codeless automation native engine to create troubleshooting for alert and remediation as per policy | |
| HCI solution should have capability for managing multiple sites/clusters from one HTML5 based browser with single sign on | |
| HCI solution should support rest API for third party integration and customized workflow for automation using rest API | |
| HCI solution should have call home capability for remote log collection and proactive support for predictive failure hardware component | |
| HCI solution should provide seamless upgrade for Firmware, Hypervisor, Storage OS, BIOS and other such functions which are required in the HCI platform. The upgrade should be online and should not be done from one single pane of management | |
| Offered solution should have inbuilt analysis for VMs and should be able to give report of VM performance for minimum 90 days. It should be possible to view constraint and overprovisioned VM from single GUI, it should be possible to create Customized Dashboard as per requirement. | |
| **Networking** | |
| Solution should provide Virtual Network visibility with application- centric protection from network threats and automation of common networking operations | |
| Solution should be able to integrate with provided orchestration layer and cloud management  platforms using programmable REST APIs/OpenFlow/Netconf to provide  end to end automation of network and security services. | |

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| Solution should integrate with 3rd party physical network & security solutions (or their managers) from leading OEMs using programmable REST APIs/OpenFlow/Netconf/Device packages to provide integration with proposed Spine-Leaf switches and existing Perimeter devices (network & Security) | |
| Solution should offer comprehensive flow assessment, analytics, security groups and firewall rules suggestion for the purpose of implementing micro level segmentation to achieve zero trust security within the data-centre | |
| Solution should provide micro segmentation (Restricted access between VMs in the same VLAN/ VXLAN as well as across VLANs/ VXLANs) using integration with proposed stateful virtual firewall | |
| Solution should support integration with Hyper Converged Infrastructure (HCI) hypervisor, Containers (running on Docker, Kubernetes) and any of public cloud | |
| Solution should provide a single centralized dashboard for managing, monitoring and provisioning of entire network & security infra inside Hyper Converged Infrastructure (HCI) cluster | |
| Solution should provide creation of security groups and security policies/rules based on parameters like virtual machine name/OS type/IP addresses/Security Tags etc. | |
| Solution should provide granular control and governance across VM to VM traffic or VMs pre-defined Group/Department | |
| Solution should Support for layer-2 VLAN for networking and integrated VM IP's Management capabilities | |
| Solution must ensure that only permitted traffic between application tiers or other logical boundaries is allowed and protects against advanced threats propagating within the virtual environment | |
| Solution must leverage virtualized network functions from third-party software (eg. virtual firewalls, load balancers, threat detection, and application performance monitoring etc.), which can be inserted in- line or in tap-mode with VM traffic, and can be easily enabled for all traffic, or deployed only for specific network traffic. | |
| Solution should integrate with L2/L3 network device with API call function for all required network configuration (L2/L3) with VM Life cycle. | |
| Solution should support VM's life cycle policy-based firewall rules for east west traffic across VM's through one management console without any third party software | |
| Solution should integrate with third party network function software like virtual load balancers, virtual firewall etc | |
| Solution should provide a single centralized dashboard for managing, monitoring and provisioning of entire network & security infra | |

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| Solution should have zero trust policy model for connected systems or hosts. | |
| Should offer control and tracking of operational user activity to meet audit and compliance requirements | |
| Solution should support traffic flows visualization with context of end-to-end Network Visibility. from the VM, to the virtual NIC all the way to the top-of-rack switch port with health and performance of the network | |
| Solution should provide network analysis solution to collect and analyze network flows in real time and put them in the context of the VMs and applications which are originating from or terminating to. Users should easily understand who is talking to whom and what flows need to be allowed or blocked. | |
| Solution should respond faster to security incidents and breaches by automating remediation processes, such as quarantining suspicious applications by integration with leading security vendors. | |
| Solution should provide the functionality to remove all the network & security policies assigned to an application/VM whenever that application is decommissioned. | |
| Solution should integrate (send, receive events, alerts to & from) with existing Network and Security monitoring tools like Network Management System (NMS), SIEM etc. | |
| Solution should integrate with SMTP for sending appropriate email related to different type of events/alerts for the cluster environment | |
| **Private Cloud Orchestrator** | |
| The solution should have catalogue of private cloud services, and should support self-service provisioning capabilities | |
| The solution should provide authentication, authorization and accounting (AAA) out of the box | |
| The solution should have Life Cycle Management Workflows: Provisioning | |
| Central administrator must be able to manage/control the marketplace view for the tenants. Any authorised user must be able to deploy the application using the published VMs in his application marketplace. | |
| The solution should provide capability of generating reports for usage & performance | |
| Ability to integrate with industry standard authentication like AD etc. | |
| The model should include at least three user levels for the Platform (Admin/User/Monitor) | |
| The solution shall provide a single pane of glass for automated provisioning with model-based orchestration of compute, network, storage through a unified multi-tenant IT service catalogue | |

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| The solution shall allow authorized administrators, developers or business users to request new IT services and manage specific cloud and IT resources, while ensuring compliance with business policies | |
| The solution must allow restriction of vCPU, Memory and Disk resources to each project or group of users | |
| The solution must allow management of existing/already provisioned VMs and perform automation task | |
| The solution must provide full audit governance on who launch the blueprint, output log of each action and script used to run the action. | |
| The solution must allow/support disk image of Windows, Windows Server, all variant of Linux. | |
| The solution must allow single management console to view the capacity, performance of the infrastructure and the blueprint designer without logging in to different url. | |
| The solution must support HTML5 | |
| The solution must provide a marketplace to allow user to consume the creation of infrastructure easily | |
| The designer can define the vCPU & memory for each virtual machine | |
| The software must be able to integrate with monitoring software. | |
| The software must be able to integrate with application security vulnerabilities detection software | |
| The Software should have user management capabilities to support the following: | |
| a) Highly configurable user role model | |
| b) Mass maintenance of a group of users | |
| The Software should support AD authentication, and synchronization of user list and profiles between Software and Active Directory setup. | |
| The solution must provide machine intelligence to continuously provide optimization recommendations. Operator should be able to easily fix security vulnerabilities and right-size resources with just one-click. The solution should provide 250+ audit checks to ensure compliance with industry standard regulatory policies and best practices are met. | |
| The application must be able to support separation of account creation and role assignment. | |
| The application must be able to support Inactive session auto logout. | |
| **Private Cloud Database Life Cycle Management Tool** | |
| The tool must provide automated provisioning of standalone or clustered databases. | |
| The tool must support all the leading databases, like Oracle, SAP HANA, MS SQL, My SQL, Postgress, Maria DB etc. | |

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| The offered DB tool must support online copy data management, with a simplified snapshot and cloning process. | |
| The Database provisioning tool should be capable of handling Database schema deployment post /pre provisioning of Database. | |
| It must allow provisioning of customised images which are tailor- made as per organisation need. | |
| The integrated copy data management must eliminate any wasteful copy data cost, as in automated deletion of old snapshots and clones as per retention policy. | |
| must provide customizable database profiles for software, compute, networking, and database parameters | |
| The tool must provide the ability to define recovery SLA's as per customizable RPO. | |
| The tool must be able to recover the DB copy from the past point-in- time to the granularity of any second, minute and hour of the day from the past. There must be daily, weekly and monthly point-in- time copies also available beyond this continuous "per-second" recovery as per the defined schedule. | |
| This point-in-time DB image must provide user the ability to restore the database on an existing DB server, or automatically create a new VM(s) and restore the DB. This must be an automated process, and user should not go through VM creation process manually. | |
| The user must be able to manage multiple DB engines, like Oracle, MS SQL, MySQL etc using the same interface and tool. | |
| The DB tool must alert the operator with any new DB patch availability, and provide an easy way to test and implement the patch on the production DB. | |
| The tool must maintain the event logs of any major activity and changes and auditing. | |
| The tool should have integration with AD/identity management. | |
| The tool must be able to integrate with the user preferred self- service tool using the API's. | |
| **Firmware Code and Patch Management** | |
| The solution should provide seamless upgrade for (but not limited to) Firmware, Hypervisor, Storage OS, SDS software, BIOS and other such functions which are required in the solution. | |
| All patches for the complete hardware and software solution must come from a single validated source. It should be possible to apply and upgrade all software and Hardware related firmware and patches from the same GUI that is used to manage the HCI (It should not use the hardware management console for doing firmware upgrade of hardware) | |

| Proactive Maintenance and Support | |
|---|---|
| Proposed Appliance should come with a single proactive incident reporting and alerting which covers both Hardware components and full Software stack. | |
| Proactive Maintenance feature should have ability to automatically send all hardware and hypervisor related alerts to the 24 x 7 Call centre of the Vendor. | |
| Original Equipment manufacturer should have online 24 x 7 support for any hardware or software related issue | |
| Proposed solution should have one window support solution for all the components including hardware, firmware and software used. The support should be from OEM. | |
| HCI solution must have direct OEM, L1, L2 and L3 support, 24x7x365 days with unlimited incident support (Telephonic/ Web/ Email) and technical contacts/contract with 60 mins or less response time including the unlimited upgrades and updates. | |

## Technical Requirements Specifications – Antivirus

| Technical Specification | Compliance (YES/NO) |
|---|---|
| Should offer comprehensive customer/server security by protecting enterprise networks from which includes virus protection, spyware, rootkits, bots, grayware, adware, malware and other computer borne threats or mixed threat attacks or any emerging cyber-attacks or zero- day attack protection. | |
| Solution Should clean computers of file-based and network viruses plus virus and worm remnants (Trojans, registry entries, viral files) through a fully-automated process. | |
| Should be able to reduce the risk of virus/malware entering the network by blocking files with real-time compressed executable files. | |
| Should include capabilities for detecting and removing rootkits | |
| Should provide Real-time spyware/grayware scanning for file system to prevent or stop spyware execution | |
| Should have capabilities to restore spyware/grayware if the spyware/grayware is deemed safe | |
| Should have Assessment mode to allow first to evaluate whether spyware/grayware is legitimate and then take action based on the evaluation | |
| Should clean computers of file-based and network viruses plus virus and worm remnants (Trojans, registry entries, viral files)—through a fully- automated process | |

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| To address the threats and nuisances posed by Trojans, the solution should be able to do the following but not limited to: | |
| a) Terminating all known virus processes and threads in memory | |
| b) Repairing the registry | |
| c) Deleting any drop files created by viruses | |
| d) Removing any Microsoft Windows services created by viruses | |
| e) Restoring all files damaged by viruses | |
| f) Includes Clean-up for Spyware, Adware etc. | |
| Should be capable of cleaning viruses/malware even without the availability of virus clean- up components. Using a detected file as basis, it should be able to determine if the detected file has a corresponding process/service in memory and a registry entry, and then remove them altogether. | |
| Should provide Outbreak Prevention to limit/deny access to specific shared folders, block ports, and deny write access to specified files and folders on selected customers in case there is an outbreak | |
| Behaviour Monitoring: | |
| a) Should have behaviour monitoring to restrict system behaviour, keeping security related processes always up and running | |
| b) Enable certification that a software is safe to reduce the likelihood of false positive detections or equivalent | |
| Should provide Real-time lock down of customer configuration allow or prevent users from changing settings or unloading/uninstalling the software | |
| Users with the scheduled scan privileges can postpone, skip, and stop Scheduled Scan. | |
| CPU/memory (physical or virtual) usage performance control during scanning: | |
| a) Checks the CPU usage level configured on the Web console and the actual CPU consumption on the computer | |
| b) Adjusts the scanning speed if: | |
| c) The CPU usage level is Medium or Low | |
| d) Actual CPU consumption exceeds a certain threshold | |
| Should have a manual outbreak prevention feature that allows administrators to configure port blocking, block shared folder, and deny writes to files and folders manually | |
| Should have Integrated spyware protection and clean-up | |
| Should have the capability to assign a customer the privilege to act as a update/master relay agent for rest of the agents in the network | |
| Shall be able to perform different scan Actions based on the virus type (Trojan/ Worm, Joke, Hoax, Virus, other) | |
| shall be able to scan only those file types which are potential virus carriers (based on true file type) | |
| Should be able to detect files packed using real-time compression algorithms as executable files. | |
| shall be able to scan Object Linking and Embedding (OLE) File | |

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| Should provide Web threat protection by the following ways: | |
| a) Should be able to protect the endpoints from Web threats by blocking access to and from malicious sites based on the URL's reputation ratings | |
| b) Should extend Web threat protection to the endpoints even when they disconnect from the network, i.e. regardless of the location | |
| c) Should have the capabilities to define Approved URLs to bypass Web Reputation policies | |
| d) Should provide real-time protection by referencing online database with millions of rated Web domains | |
| e) Configure Web reputation policies and assign them to individual, several, or all end users machine. | |
| Should provide File reputation service | |
| a) Should be able to check the reputation of the files hosted in the internet | |
| b) Should be able check the reputation of the files in webmail attachments | |
| c) Should be able to check the reputation of files residing in the computer | |
| Should protect customers and servers on the network, high performance network virus scanning, and elimination. | |
| Should provide the flexibility to create firewall rules to filter connections by IP address, port number, or protocol, and then apply the rules to different groups of users | |
| Should have smart feedback to enable feedback from the customer agents to the threat research Centers of the vendor. | |
| Uses any alternate method other than the conventional pattern based scanning with the following features: | |
| a) Provides fast, real-time security status lookup capabilities in the cloud | |
| b) Reduces the overall time it takes to deliver protection against emerging threats | |
| c) Reduces network bandwidth consumed during pattern updates. The bulk of pattern definition updates only need to be delivered to the cloud or some kind of repository and not to many endpoints | |
| d) Lowers kernel memory consumption on endpoints. Consumption increases minimally over time. | |
| Should be able to deploy the Customer software using the following mechanisms: | |
| a) Customer installation Package (Executable & Microsoft Installer (MSI) Package Format), should support silent installer, unmanaged customers, specific installer for servers | |
| b) Web install page | |
| c) Login Script Setup | |
| d) Remote installation | |
| e) From a customer disk image | |
| Should provide a secure Web-based management console to give administrators transparent access to all customers on the network | |

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| The management server should be able to download updates from different source if required. | |
| Should reduce network traffic generated when downloading the latest pattern by downloading only incremental patterns. | |
| Should have the flexibility to roll back the Virus Pattern and Virus Scan Engine if required via the web console | |
| Should have role based administration with active directory integration | |
| a) To create custom role type | |
| b) To add users to a predefined role or to a custom role | |
| Should have integration with the Active directory 2008/2012 or higher | |
| Shall support grouping of customers into domains for easier administration & Endpoint security solution should provide vulnerability protection, which should scan the machine and provide CVE number visibility and accordingly recommend rule for virtual patch against vulnerability. | |
| Establish separate configuration for internally versus externally located machines ( Policy action based on location awareness ) | |
| Should be capable of uninstalling and replacing existing customer antivirus software and to ensure unavailability of any residual part of the software. | |
| Security Compliance should leverage Microsoft Active Directory services to determine the security status of the computers in the network | |
| Should have a feature similar to Firewall Outbreak Monitor which sends  a customized alert message to specified recipients when log counts from customer IPS, customer firewall, and/or network virus logs exceed certain thresholds, signalling a possible attack. | |
| Should be able to send a customized notification message to specified recipients when firewall violations exceed certain thresholds, which may signal an attack | |
| Should perform Boot & Rootkit scan and cleaning, Endpoint security solution should have capability of AV, Zero day threat protection, Vulnerability protection, Firewall, Device control, virtual Patching and integrated DLP with pre and post machine  learning execution for malware analysis | |
| Virus definition files should be lighter so that same can be transmitted to remote locations having minimum of 64kbps link or the update pattern size should be less than 200Kb | |
| System should be configured in such a way that at no case no endpoints/remote agents will be able to communicate with OEM cloud for obtaining updates through internet. | |
| In case of bot infection, bot removal tools also to be facilitated to clean the infected machine | |
| The solution should have latest machine learning technology in built from day one. | |
| The solution should have the option of the endpoint vulnerability shielding in | |

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| the network. | |
| The solution should have ransomware protection in built. | |
| Solution should have URL and web filtering at gateway level for web security | |
| Solution should support IPv4 and IPv6 from day one | |
| Warranty and Maintenance | |
| The bidder should provide comprehensive warranty till end of contract period with 24 x 7 x 365 for all equipment and software included in the proposed solution. | |

**Technical Requirements Specifications- Networking Switches**

| Specifications for Distribution/ToR Switches | Compliance (YES/NO) |
|---|---|
| **Solution Requirement** | |
| The Switch should support non-blocking Layer 2 switching and Layer 3 routing | |
| There switch should not have any single point of failure like power supplies and fans etc. should have 1:1/N+1 inbuilt level of redundancy | |
| Hardware and Interface Requirement | |
| Switch should have the 24 x 1/10/25G SFP and should have 4 x 40G/100G QSFP28 ports. The switch should be scalable to additional 50% of the asked above ports, switch should be populated with 16x10G Multimode SFP and 2x100G ports. | |
| Switch should have 16GB DRAM and 32GB internal Flash/Storage | |
| Switch should support Configuration roll-back | |
| Switch should support for different logical interface types like loopback, VLAN, SVI/RVI, Port Channel, multi chassis port channel/LAG etc. | |
| The switch should support 80,000 IPv4 unicast routes and 80,000 IPv6 unicast routes entries in the routing table including 40,000 multicast routes | |
| The switch should support hardware based load sharing at wire speed using LACP and multi chassis ether channel/LAG | |
| Switch should support minimum 3 Tbps of switching capacity | |
| Layer2 Features | |
| Spanning Tree Protocol (IEEE 8201.D, 802.1W, 802.1S) | |
| Switch should support minimum 256,000 no. of MAC addresses | |
| Switch should support 8 Nos. of link or more per Port channel (using LACP) and support 64 number of ports per Link Aggregation Group | |
| Support for broadcast, multicast and unknown unicast storm control to prevent degradation of switch performance from storm due to network attacks and vulnerabilities | |
| **Layer3 Features** | |
| Switch should support static and dynamic routing like Static, OSPF and BGP | |
| Switch should support a datacentre Fabric build on mature standards and protocols such as BGP EVPN/VXLAN to normalize datacentre and fabric operations. No proprietary solutions are to be deployed for fabric | |
| Should support BGP, MBGP, IS-IS for IPv4 and IPv6 | |
| Switch should support multicast traffic reachability using PIM-SM and SSM | |
| Availability | |
| Switch should provide gateway level of redundancy in IPv4 and IPv6 using HSRP/ VRRP | |

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| Switch should support for BFD For Fast Failure Detection | |
| **Quality of Service** | |
| Switch system should support 802.1P classification and marking of packet CoS, DSCP etc. | |
| Switch should support for different type of QoS features for real time traffic differential treatment using WRED and SP Queuing | |
| Switch should support Flow control of Ethernet ports to control traffic rates during congestion by allowing congested nodes to pause link operation at the other end for receiving traffic as per IEEE 802.3x | |
| **Security** | |
| Switch should support for deploying different security for each logical and physical interface using Port Based access control lists of Layer-2 to Layer-4 in IP V4 and IP V6 and logging for fault finding and audit trail | |
| Switch should support control plane i.e. processor and memory Protection from unnecessary or DoS traffic by control plane protection policy | |
| Switch should support AAA using TACACS+ / Radius | |
| Switch should support for Role Based access control (RBAC) for restricting host level network access as per policy defined | |
| **Manageability** | |
| Switch should support for RMON/RMON-II for central NMS management and monitoring | |
| Switch should provide remote login for administration Telnet, SSHv2 | |
| Switch should support for management and monitoring status using different type of Industry standard NMS using SNMP V2 and V3 | |
| Switch should support for basic administrative tools like Ping and traceroute | |
| Switch should support central time server synchronization using Network Time Protocol NTP V4 | |
| Switch should be IPv6 Certified (IPv6 Logo Ready or USGv6) | |
| Switch should be EAL3/ NDPP /NDcPP or above Certified under common criteria | |
| **Out of Band Management** | |
| The DC Switches should have the capabilities to be deployed and managed by an software solution installed on a ESXi or KVM Hypervisor as an Out of Band Management tool. | |
| OOB Management Tool should provide full lifecycle management of the network including Design, Build, Deployment and Validation and support Zero Touch provisioning that takes a device from initial boot to a point where it is managed by the Fabric Manager. | |

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| OOB management Tool should support DC switching design with industry standard protocols like Ethernet, IP, BGP in the physical/underlay and EVPN-VXLAN in the overlay of the proposed architecture with visualizations for path analysis, heat maps and bandwidth | |
| Should support Network Virtualization Overlays with VXLAN data plane, EVPN control plane, Edge-Routed Bridging Overlay and Proxy ARP and ND | |
| Should support deployment of 3-Stage and 5-Stage leaf-spine IP fabrics with Multihoming by using industry standard EVPN ESI with multi-tenancy and workload isolation at Layer-2 and Layer-3 using VLAN, VXLAN, EVPN, VRF (Routing Instance) and Group Based Policies | |
| Should support anycast gateway that configures every SVI/IRB interface that participates in the stretched L2 service with the same IP/MAC address | |
| Should provide full network-centric DC Switching Infra health view to operations and NOC teams using built-in Dashboards which presents contextualized information on a wide range of categories including BGP status, Physical Layer-1 Visualizations, Interface Expectations, Configuration compliance, Revenue facing Servers, Deployment Anomalies, Routing Anomalies, Hardware (CPU, TCAM, Memory, Power), Configuration Deviation | |
| Solutions should provide Advanced telemetry that can collect streaming telemetry data from switches and monitor and get alerts on data transfers across a fabric | |
| Should support creation of Service Level Agreements in one central location and alert anytime there is a deviation from defined properties. Should have ability to check the compliance of devices and services across the entire fabric. | |
| Should support Role-based Access Control (RBAC) for logging into OOB Management tool. Should support LDAP, AD, TACACS+, and RADIUS for authenticating and authorizing users and should support Restful APIs for 3rd Party Integrations. | |
| **Warranty and Maintenance** | |
| The bidder should provide comprehensive warranty till end of contract period with 24 x 7 x 365 for all equipment and software included in the proposed solution. | |

**Technical Requirements Specifications – Firewall**

| Technical specifications | Compliance (YES/NO) |
|---|---|
| **General** | |
| The vendor must attain ISO 9001:2000 certification that covers scope of the Quality Management System which includes the design, development and manufacturing of network security products and the delivery of associated security services and support | |
| The device should attains ICSA or NSS Labs Certifications or Equivalent certification | |
| The proposed system must Provide protection over IPv4 and IPv6 | |
| The proposed system shall support dual hot-swappable power supplies. | |
| The proposed solution must be recognized as a Leader/Challenger in the latest Gartner Magic Quadrant for latest Network Firewalls (2019 or 2020 or 2021). | |
| Upgradeable via Web UI or TFTP | |
| Be easily backup or restored via GUI and CLI to/from local PC, remote centralized management or USB disk | |
| Provide CLI to troubleshoot. | |
| Have option for encrypted backup file | |
| The proposed system shall have option to implement local administrator password policy enforcement including: | |
| a) Minimum length | |
| b) Character requirements - Upper case, lower case, numbers and special character | |
| c) Disallow password reuse | |
| d) Password expiration | |
| The administrator authentication shall be facilitated by local database, PKI & remote services such as Radius, LDAP and TACACS+ | |
| The proposed system shall support profile base login account administration, offering gradual access control such as only to Policy | |
| Configuration & Log Data Access | |
| The proposed system shall be able to limit remote management access: | |
| a) From certain trusted network or host with corresponding administrator account | |
| b) To certain (virtual) interfaces | |

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| The proposed system shall allow GUI configurations to external services that includes External threat feeds: | |
| **Firewall** | |
| The Firewall should be Hardware based, Reliable, purpose-built security appliance with hardened operating system that eliminates the security risks associated with general-purpose operating systems | |
| Firewall appliance should have at least 16 x 1GE RJ45 interface, 8 x 1GE SFP slot 4 x 10G SFP+ slot, 8 x 10GE SFP+ and scalable to additional 2x40 GE QSFP+ in future with in the same appliance. | |
| Firewall Throughput should be 80 Gbps | |
| Firewall should have minimum 40 Gbps of VPN throughput | |
| Firewall should have 50000 site-to-site & client to site VPN Tunnels. | |
| Firewall should have minimum 8000 concurrent SSL VPN users. | |
| Firewall should have 450,000 new sessions per second | |
| Firewall should have 8 Million concurrent sessions | |
| The solution should have minimum 9 Gbps of NGFW throughput for Mix / production traffic | |
| The solution should have minimum 7 Gbps of Threat Prevention throughput for Mix / production traffic | |
| The Firewall solution should support NAT64 and DNS64 | |
| The proposed system shall be able to operate on either Transparent (bridge) mode to minimize interruption to existing network infrastructure or NAT/Route mode. Both modes can also be available concurrently using Virtual Contexts. | |
| The proposed system should have integrated Traffic Shaping functionality. | |
| The proposed system should support IPSEC VPN | |
| The device shall utilize inbuilt hardware VPN acceleration: | |
| a) IPSEC (DES, 3DES, AES) encryption/decryption | |
| b) SSL encryption/decryption | |
| The system shall support the following IPSEC VPN capabilities: | |
| a) Multi-zone VPN supports. | |
| b) IPSec, ESP security. | |
| c) Supports NAT traversal | |
| d) Supports Hub and Spoke architecture | |
| e) Supports Redundant gateway architecture | |
| The system shall support 2 forms of site-to-site VPN configurations: | |
| a) Route based IPSec tunnel | |
| b) Policy based IPSec tunnel | |
| The system shall provide IPv6 IPSec feature to support for secure IPv6 traffic in an IPSec VPN. | |

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| **Virtualization** | |
| The proposed solution should support Virtualization (Virtual Firewall, Security zones and VLAN). Minimum 10 Virtual Firewall license should be provided. | |
| **Antivirus** | |
| Firewall should have integrated Antivirus solution | |
| The proposed system should be able to block, allow or monitor only using AV signatures and file blocking based on per firewall policy based or based on firewall authenticated user groups with configurable selection of the following services: | |
| a) HTTP, HTTPS | |
| b) SMTP, SMTPS | |
| c) POP3, POP3S | |
| d) IMAP, IMAPS | |
| e) FTP, FTPS | |
| The proposed solution should be able to detect and prevent advanced Malware, Zero-day attack, spear phishing attack, drive by download, watering hole and targeted Advanced Persistent Threat without relying on just Signature database. | |
| The proposed solution should be able to perform dynamic real-time analysis of advanced malware on the appliance itself to confirm true zero- day and targeted attacks. Cloud infrastructure system for analysis and detection of Malware. | |
| The proposed system should be able to block or allow oversize file based on configurable thresholds for each protocol types and per firewall policy. | |
| **Web Content Filtering** | |
| The proposed system should have integrated Web Content Filtering solution without external solution, devices or hardware modules. | |
| The proposed solution should be able to enable or disable Web Filtering per firewall policy or based on firewall authenticated user groups for both HTTP and HTTPS traffic. | |
| The proposed system shall provide web content filtering features: | |
| a) which blocks web plug-ins such as ActiveX, Java Applet, and Cookies. | |
| b) Shall include Web URL block | |
| c) Shall include score-based web keyword block | |
| d) Shall include Web Exempt List | |
| The proposed system shall be able to queries a real time database of over 110 million + rated websites categorized into 70+ unique content categories. | |
| **Application Control** | |
| The proposed system shall have the ability to detect, log and take action against network traffic based on over 2000 application signatures | |
| The application signatures shall be manual or automatically updated | |

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| The administrator shall be able to define application control list based on selectable application group and/or list and its corresponding actions | |
| **Data Leakage Prevention** | |
| The proposed system shall allow administrator to prevent sensitive data from leaving the network. Administrator shall be able to define sensitive data patterns, and data matching these patterns that will be blocked and/or logged when passing through the unit. | |
| **High Availability** | |
| The proposed system shall have built-in high availability (HA) features without extra cost/license or hardware component | |
| High Availability Configurations should support Active/Active or Active/ Passive | |
| The proposed system shall support high availability by setting up a cluster with the following characteristics: | |
| Supports up to 4 cluster members | |
| Supports 2 HA modes; active-passive (failover HA) and active-active (load balancing HA) | |
| Cluster units communicate with each other through their heartbeat interfaces | |
| Uses a combination of incremental and periodic synchronization to make sure that the configuration of all cluster units is synchronized to that of the primary unit | |
| Provides device failover in the event of hardware or software failure | |
| Provides link failover when a direct link is not available on one/more monitored interface(s) | |
| Provides remote link failover when connectivity with IP addresses of remote network devices, for example, a downstream router is not available | |
| In the event of a failover, log messages about the event and can be configured to send log messages to a syslog server. The cluster can also send SNMP traps and alert email messages | |
| The proposed system shall support out-of-band management for each cluster member where a management interface is reserved with its own configurations and are not synchronized to other cluster units. | |
| The proposed system shall support the upgrade of the firmware without interrupting communication through the cluster | |
| **Logs and Report** | |
| Should have 900 Gbps of Hard Drive Capacity for logging and reporting if not please quote separate appliance | |
| Real-time display of information allows you to follow real-time trends in network usage such as the source IP address and the destination URL for HTTP traffic. | |

| Warranty and Maintenance | |
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| The bidder should provide comprehensive warranty till end of contract period with 24 x 7 x 365 for all equipment and software included in the proposed solution. | |

# Project Implementation Schedule

The Project Implementation Schedule for AMI system establishment and timelines for Related Services milestones from date of execution of the Contract are given below:

| S. No. | Milestone | Timeline (in months) |
|---|---|---|
| 1 | Submission of detailed Project Implementation Plan giving the compliance sheet along with the make and model of various infrastructure, hardware & software that are proposed for delivery and operations incl.:<br>• Specification of System<br>• Architecture and Software Solution | Within 60 days from the date of execution of the Contract |
| 2 | Approval of detailed Project Implementation Plan by Utility | Within 30 days from the date of<br>Submission of Project Implementation Plan. |
| 3 | Delivery, site installation, integration and operationalization of 100% of Feeder Meters each with related hardware, software and equipment | Within [9] months from the date of execution of the Contract |
| 4 | • Delivery, site installation and commissioning of Network Operations cum Monitoring Centre with related hardware, software and equipment; and<br>• Delivery, site installation, integration and operationalization of 5% of Smart Meters each with related meter box, service cable, hardware, software and equipment and successful operational go-live | Within 10 months from the date of execution of the Contract |
| 5 | Delivery, site installation, integration and operationalization of 50% of Smart Meters each with related meter box, service cable, hardware, software and equipment | Within 20 months from the date of execution of the Contract |
| 6 | Delivery, site installation, integration and | Within 20 months from the |

| S. No. | Milestone | Timeline (in months) |
|---|---|---|
| | operationalization of 100% of DT Meters each with related hardware, software and equipment | date of execution of the Contract |
| 7 | Installation Milestone (100%) | Within 36 months from the date of execution of the Contract |
| 8 | Certification of Installation Milestone in accordance with the provisions of this Contract by Utility | Within 30 days from the date of Installation Milestone. |
| 9 | Operational period of the AMI system | From Operational Go-Live till end of the Contract Period |
| 10 | Transfer of AMI system to the utility | At the end of Term of the Contract in accordance with Exit Management Plan provided in Article 11.6 of GCC in Section 7 |

**Installation Milestone**

The "Installation Milestone" is defined as the milestone when installation and operation is completed for the number of smart meters envisaged for the project. The AMI Service Provider is expected to complete this Installation Milestone as per the table given above. The number of smart meters envisaged may change through negative variations provided for in the Contract as mentioned in Article 14 given in Section 7. If the AMI Service Provider completes the "Installation Milestone" ahead of schedule, then the revised date shall be accepted as the date of achievement of "Installation Milestone".

In accordance with Clause 1.15 (w) of this Section, the Utility shall provide necessary clearance/ approval/ permits that are to be issued by it for initial 20% of contiguous electrical locations for Smart Meter deployment along with related documentation within 6 (six) months from date of execution of this Contract. Furthermore, the Utility shall provide necessary clearance/ approval/ permits to be issued by it for remaining contiguous electrical locations as well as non-contiguous electrical locations for Smart Meter deployment along with related documentation on quarterly basis. Utility shall endeavour to provide 20% of contiguous electrical locations cleared each quarter and complete area within 18 (eighteen) months from date of execution of the Contract. The Utility shall issue a Notice no later than 7 days of expiry of time period specified above confirming the actual number of meters for which clearance/ approval/ permits is available. If the Utility fails to issue the necessary clearance and approvals or if the Utility acknowledges that no further consumer/feeder locations are available for deployment within the allotted time, then the meter population for which clearance/ approval/ permits is available shall be assumed as the number required for meeting the "Installation Milestone".

As and when the "Installation Milestone" is achieved by the AMI Service Provider, the Utility shall be obliged to certify the milestone through a written communication giving the date and the meter population installed and operationalised.