PFC CONSULTING LTD.

(A Wholly Owned Subsidiary of Power Finance Corporation Ltd. -

A Government of India Undertaking)

invites

E-Tender

on behalf of

Himachal Pradesh State Electricity Board Ltd.

For

"Selection of AMI Implementing Agency for implementation of Smart Metering in Shimla and Dharamsala City in Himachal Pradesh"

Volume-II

(Technical Scope, Functional Requirement & Service Level Agreement)

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September 20, 2019

Disclaimer

1. The information contained in this RFP or subsequently provided to Bidder(s), whether verbally or in documentary or in any other form by or on behalf of PFCCL or any of its employees, Bidders or associates, is provided to Bidder(s) on the terms and conditions set out in this RFP and such other terms and conditions subject to which such information is provided.

2. This RFP is not an agreement and is neither an offer nor invitation by PFCCL to the prospective Bidders or any other party. The purpose of this RFP is to provide interested parties with information that may be useful to making their Bid. This RFP includes statements, which reflect various assumptions and assessments arrived at by PFCCL in relation to the Project. Such assumptions, assessments and statements do not support to contain all the information that each Bidder may require. This RFP may not be appropriate for all persons, and it is not possible for PFCCL to consider the technical capabilities, investment objectives, financial situation and needs of each party who reads or uses this RFP. The assumptions, assessments, statements and information contained in this RFP may not be complete, accurate, adequate or correct. Each Bidder should, therefore, conduct its own investigations and analysis and should check the accuracy, adequacy, correctness, reliability and completeness of the assumptions, assessments, statements and information contained in this RFP and obtain independent advice from appropriate sources.

3. Information provided in this RFP to the Bidder(s) is on a wide range of matters, some of which depends upon interpretation of law. The information given is not an exhaustive account of statutory requirements and should not be regarded as a complete or authoritative statement of law. PFCCL accepts no responsibility for the accuracy or otherwise for any interpretation or opinion on law expressed herein.

4. PFCCL or any of its employees, Bidders or associates make no representation or warranty and shall have no liability to any person including any Bidder under any law, statute, rules or regulations, principles of restitution or unjust enrichment or otherwise for any loss, damages, cost or expense which may arise from or be incurred or suffered on account of anything contained in this RFP or otherwise including the accuracy, adequacy, correctness, completeness or reliability of the RFP and any assessment, assumption, statement or information contained therein or deemed to form part of this RFP or arising in any way in this Bid stage.

5. PFCCL or any of its employees, Bidders or associates also accept no liability of any nature whether resulting from negligence or otherwise howsoever caused arising from reliance of any Bidder upon the statements contained in this RFP.

6. PFCCL may in its absolute discretion, but without being under any obligation to do so, update, amend or supplement the information, assessment or assumptions contained in this RFP.

7. The issue of this RFP does not imply that PFCCL is bound to select a Bidder for the Project and PFCCL reserves the right to reject all or any of the Bidders or Bids or discontinue or cancel the bidding process without assigning any reason whatsoever.

8. The Bidder shall bear all its costs associated with or relating to the preparation and submission of its Bid including but not limited to preparation, copying, postage, delivery fees, traveling, food, lodging, expenses associated with any demonstrations or presentations which may be required by PFCCL or any other costs incurred in connection with or relating to its Bid. All such costs and expenses will remain with the Bidder and PFCCL shall not be liable in any manner whatsoever for the same or for any other costs or other expenses incurred by a Bidder in preparation for submission of the Bid, regardless of the conductor outcome of the Bidding Process.

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Definitions

1.	**"AMI Implementing Agency" or "AMI-IA"**	:	Same as "Project Implementing Consortium"
2.	**"Bid(s)"**	:	The bid submitted by the Bidder(s) in response to this RFP
3.	**"Bidder(s)"**	:	Any or all Consortium Members including the Lead Consortium Member bidding as a response to this RFP
4.	**"Bidding Consortium"**	:	The Consortium of Bidders legally bound as per the terms and formats of this RFP to bid for the Project.
5.	**"Consortium Member"**	:	Any Member of the Bidding Consortium other than the Lead Consortium Member.
6.	**"Contract"**	:	The Agreement between PFCCL and the Successful Bidder upon receiving the Letter of Award from PFCCL for implementation of the Project.
7.	**"Contractor"**	:	Same as "Project Implementing Consortium"
8.	**"Employer"**	:	Same as the "Project Management Agency" or PMA
9.	**"Financial Year" or "FY"**	:	Period starting from 1 April of the first calendar year to 31 March of the consecutive calendar year.
10.	**"Lead Consortium Member"**	:	The Consortium Member taking the lead in submitting this RFP with eligibility, roles and responsibilities outlined in Volume 1 Clause 4.3.2 of this RFP and duly supported by the legal agreements as per formats in this RFP.
11.	**"MTS"**	:	Minimum Technical Standards as defined in Volume 2 of this RFP.
12.	**"Party" or "Parties"**	:	PFCCL, HPSEB, the Bidder, and the Project Implementing Consortium, individually or collectively, respectively.
13.	**"Project"**	:	HPSEB's AMI Project defined in Section 1.
14.	**"Project Implementing Consortium" or "Contractor" or "AMI-IA"**	:	The Consortium or the Contractor with the lowest Price (L-1) after reverse auction appointed by PFCCL upon signing of the Contract subsequent to the Letter of Award

15.	**"Project Management Agency" or "PMA"**	:	Project Management Agency is PFCCL.
16.	**"Request for Proposal" or "RFP"**	:	This Tender No. **Smart_Metering/Himachal_Pradesh/A136** including all its Volumes for Appointment of AMI Implementing Agency (including all clarification/ addendum/ amendment/ corrigendum/ etc.
17.	**"Rupees" or "Rs." Or "INR" or "₹"**	:	Indian Rupees
18.	**"Service(s)" or "Related Service(s)"**	:	Any service(s) performed or to be performed as a part of the Solution by the Contractor.
19.	**"Solution"**	:	The system within the Scope of Work of the Project as defined by this RFP, and implemented in its entirety including but not limited to the supply of hardware, transportation, software, installation, integration, testing, commissioning, training operation, maintenance and other services by the Project Implementing Consortium.
20.	**"Successful Bidder"**	:	Successful Qualifying Bidder/ Consortium with the lowest Price (L-1) after reverse auction
21.	**"Tender"**	:	Same as "RFP"

Abbreviations

ACL	Access Control List
AMC	Annual Maintenance Charges
AMI	Advanced Metering Infrastructure
ANSI	American National Standards Institute
BCS	Base Computing System
BIS	Bureau of Indian Standards
BOQ	Bill of Quantity
CAIDI	Customer Average Interruption Duration Index
CAIFI	Customer Average Interruption Frequency Index
CEA	Central Electricity Authority
CEN	European Committee for Standardization
CENELEC	European Committee for Electrotechnical Standardization
CERT-In	Indian Computer Emergency Response Team
CIM	Common Information Model
CIS	Consumer Information System
CISPR	International Special Committee on Radio Interference
CPU	Central Processing Unit
CRM	Customer Relationship Management
CT	Current Transformer
DBMS	Database Management System
CUM	Cumulative
DMZ	Demilitarized Zone
DCU	Data Concentrator Unit
DXF	Drawing Exchange Format
DT	Distribution Transformer
ESB	Enterprise Service Bus
ETSI	European Telecommunications Standards Institute
FAT	Factory Acceptance Test
GPRS	General Packet Radio Service
GIS	Geographic Information System

HDD	Hard Disk Drive
GPS	Global Positioning System
GUI	Graphical User Interface
HIDS	Host-based Intrusion Detection System
HES	Head End System
HHU	Hand Held Unit
IBMS	Integrated Building Management Systems
IDS	Intrusion Detection Systems
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
IP	Internet Protocol
IS	Indian Standard
ITU	International Telecommunication Union
ISP	Internet Service Provider
IVRS	Interactive Voice Response System
LCD	Liquid Crystal Display
kVA	kilo Volt-Ampere
kW	kilo Watt
LAN	Local Area Network
LED	Light Emitting Diode
MCB	Miniature Circuit Breaker
LT	Low Tension
MICC	Mineral-Insulated Copper-Clad Cable
MD	Maximum Demand
MDAS	Meter Data Acquisition System
MDMS	Meter Data Management System
NABL	National Accreditation Board for Testing and Calibration Laboratories
NCIIPC	National Critical Information Infrastructure Protection Centre
NAN	Neighbourhood Area Network
NIC	Network Interface Card
NIPS	Network based Intrusion Prevention System

NTP	Network Time Protocol
NMS	Network Management System
OEM	Original Equipment Manufacturer
OSF	Open Software Foundation
OS	Operating System
PT	Potential Transformer
PLCC	Power Line Carrier Communication
PV	Photovoltaic System
QA	Quality Assurance
QC	Quality Control
QR	Qualification Requirement
RAM	Random Access Memory
R-APDRP	Restructured Accelerated Power Development and Reforms Programme
RDBMS	Relational Database Management System
RF	Radio Frequency
RFP	Request for Proposal
RPO	Recovery Point Objective
RTC	Real Time Clock
RTO	Recovery Time Objective
SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
SAN	Storage Area Network
SAT	Site Acceptance Test
SCADA	Supervisory Control and Data Acquisition
SLA	Service Level Agreement
SNMP	Simple Network Management Protocol
SOA	Service Oriented Architecture
SQL	Structured Queried Language
TCP	Transmission Control Protocol
TOD	Time of Day
TOU	Time of Use

UDP	User Datagram Protocol
UPS	Uninterrupted Power Supply
VEE	Validation Estimation and Editing
WAN	Wide Area Network
WPC	Wireless Planning & Coordination Wing
XML	Extensible Markup Language

1. Introduction and General Information

1.1 Background

1.1.1 HPSEB Ltd. has appointed PFC Consulting Ltd. (PFCCL) as the "Project Management Agency (PMA)" or the "Employer" for designing, financing, implementing, operating and transferring the AMI project in Shimla & Dharamsala Cities of Himachal Pradesh. PMA will appoint the AMI Implementation Agency (on behalf of HPSEB Ltd.), finance the project and manage the entire project deployment and its operations. The project will be transferred to the utility at the end of the project period on as-is-where-is basis. The PMA will interface with both the utility and Contractor. As such, the Contractor will be interfaced with the PMA from both project implementation and contractual purposes. The roles and responsibilities of the Contractor and payment thereof are governed by the Terms and Conditions of this RFP.

1.2 Project Objective

1.2.1 HPSEB Ltd. proposes to implement Smart Metering/ AMI Project in Shimla and Dhramsala towns of Himachal Pradesh.

1.2.2 Detailed Project Report (DPR) for undertaking the above project has been approved by the Monitoring Committee, MoP for around 1.35 lakh Smart Meters with a GoI Grant under IPDS

1.2.3 This Request for Proposal (this "RFP") is issued by PFCCL on behalf of HPSEB Ltd. for selecting a Consortium or a Contractor for supply, installation, testing, commissioning and maintenance of Advanced Metering Infrastructure, including smart meters (with/without net-metering) with Pre-paid configuration, communication infrastructure along with applications for Head End System (HES), Meter Data Management (MDM) System for rolling out around 1,35,000 Smart Metering (plus additional installation of smart meters as per new connection requirement in Operation and Maintenance (O&M) period) including O&M services for AMI establishment in Shimla & Dharamshala towns under Himachal Pradesh State Electricity Board Ltd. (HPSEB). The project shall also include integration of HES with MDMS and MDMS with existing and future Utility applications as defined in this specification document.

1.2.4 The key strategic objectives for AMI implementation include:
   a. **Achieve Operational Efficiencies**: Reduced operating costs in areas such as meter reading and punching, connection/disconnection, consumer complaints, reduced float between meter reading and bill generation
   b. **Revenue Protection**: Reduced commercial loss with accurate energy accounting, detection of meter tampering and improved meter reading accuracy
   c. **Improved Load and Power Quality Management**: Better visibility of loading and power quality factors on the transformers to enable accurate capacity planning and prevention of failure/under-utilization of asset
   d. **Faster Outage Detection**: Near real time notification outages to enable faster detection and restoration
   e. **Keep Customer Bills Low:** achieving the conservation benefits, operational efficiencies, and revenue protection lead to utility rate reductions which translate directly into customer savings.
   f. **Improved Customer Service:** Provide near real-time, accurate and detailed information on consumption, cost and outages

g. **Achieve Energy Efficiency:** Ability to monitor electricity consumption in near real time, consumers can manage consumption to achieve energy efficiency and save money

h. **Achieve Environment and Social Benefits:** Facilitating energy efficiency, improved load management and reduced commercial losses to enable reduced greenhouse gas emissions

i. **Support Advanced Customer Applications:** provide a substantial portion of the foundational infrastructure required to modernize the grid in support of advanced customer applications such as distributed generation, electric vehicles, demand response, micro-grids, and future applications.

1.2.5 These additional features should also be considered
   a. Energy audits can be done at distribution transformer level as per desired frequency to check leakage and pilferage
   b. Load pattern of individual consumer can be observed
   c. Withdrawal of power above sanctioned load may be monitored and controlled
   d. Tampering may be checked in near real time
   e. Control actions from control centre for load curtailment may be taken
   f. Sending alert to consumer for higher load withdrawal, bill non-payment etc.
   g. Signal transmission for variable pricing,
   h. Customer participation in demand response programmes

1.3   About HPSEB and the AMI Project

1.3.1 The details are given in clause 3.2 of Volume-1 of the RfP.

1.4   Scope of Work

1.4.1 The bidder's scope of work shall include, in complete conformity with subsequent sections of the specifications, site survey, planning, design, engineering, manufacturing, procure, supply, transportation & insurance, delivery at site, unloading, handling, storage, installation, integration, testing, commissioning, demonstration for acceptance, training, maintenance and documentation of:

i. **Single phase whole current Smart Meter** (with/without net-metering) with Pre-paid configuration and with suitable communication technology (Smart Meters proposed shall be able to work in pre-paid as well as post-paid configuration as per the HPSEB's Needs. There should not be restriction in case HPSEB wants to use some Smart Meters in Pre-Paid and some in Post-Paid mode)

ii. **Three phase whole current Smart Meter** (with/without net-metering) with Pre-paid configuration and with suitable communication technology (Smart Meters proposed shall be able to work in pre-paid as well as post-paid configuration as per the HPSEB's Needs. There should not be restriction in case HPSEB wants to use some Smart Meters in Pre-Paid and some in Post-Paid mode)

iii. **CT operated three phase Smart Meter** (with/without net-metering) with Pre-paid configuration and with suitable communication technology (Smart Meters proposed shall be able to work in pre-paid as well as post-paid configuration as per the HPSEB's Needs.

There should not be restriction in case HPSEB wants to use some Smart Meters in Pre-Paid and some in Post-Paid mode)

iv. **RF canopy or GPRS based communication:** Router based canopy type Radio Frequency (RF) network (based on Radio Frequency (RF) mesh Licensed frequency band as permitted by Wireless Planning & Coordination Wing (WPC) or in Unlicensed frequency band) (Wherever RF is not feasible GPRS based communication shall be established) for communication of data between field equipment/ smart meters and the cloud services shall be established as per the specifications mentioned in this document and to ensure the performance level given in this document to cover towns of HPSEB for congested/ highly populated areas. The network would provide a medium for two-way communication between various nodes & Head End System (HES). Different nodes shall interconnect with each other using RF mesh network and they shall communicate with nearby routers/ DCU to transfer the data to access points/ HES. The following activities shall be performed to complete installation of RF Canopy:
   a. Site survey for identification of Consumers, Distribution Transformers, Feeders and Sub-Station for the installation of Smart Meters. The geographical boundary will be boundary of Sub-Divisions for conducting the site survey
   b. Sub-Divisions wise consumer report will be prepared for implementation of Smart Metering project
   c. The Contractor has to assess and maintain buffer so that in case of new installation, smart meters are installed by the Contractor without any delay
   d. Site survey for selection of communication technology and telecom operator
   e. Site Survey for identification of location for installation of routers/ / DCU and collectors.
   f. Noise Analysis of RF communication through software tools.
   g. Deployment of Canopy elements viz. Routers and Collectors.
   h. Wherever RF is not feasible GPRS based communication shall be established.

v. Integration of Network Integration Card (NIC)/ Communication Module with meters of at least 3 manufacturers in India, to enable the respective meters to seamlessly integrate with proposed HES and MDMS thus enabling interoperability of the system. In future, it would be bidders' responsibility to integrate new meter or any other application/equipment as decided by HPSEB.

vi. Head End System (HES) / Meter Data Acquisition System (MDAS) - The objective of HES is to obtain data from various end points and remotely monitor the data.

vii. Meter Data Management (MDM) System (shall be developed on a COTS product platform and must have been deployed and functional in at least two utilities.) Meter Data Management is the central application for AMI Solution which will contain the repository for entire details of meter, consumers and perform different operations i.e. validation, estimation & editing of received meter data. MDMS is the central data repository of all the captured data.

viii. Integration of HES with MDMS & MDMS with existing applications of HPSEB. The MDMS shall be integrated with legacy applications installed under the RAPDRP Program or any other projects of HPSEB. The integration would be done with the Billing system, MDAS

system etc. The scope will also cover the future integration requirement given by HPSEB till the contract period i.e. including O&M period.

ix. **IT System -** Design, procure, supply, installation, testing, Cyber Security, commission and operation & maintenance of complete IT System. IT Infrastructure shall be on cloud to host the HES, MDM and Web Applications. Security of data hosted on cloud shall also be the responsibility of the Contractor. System Security and access with due consideration of data privacy, confidentiality cyber security guidelines.

x. Integration of IT System with the existing system of HPSEB or to facilitate or provide full support for any new future integration requirement of HPSEB.

xi. Mobile app (Android and iOS based) for consumers

xii. Other necessary software with valid licenses.

xiii. Integration of different devices/equipment/software covered in scope of this project with each other as per functional requirements

xiv. Integration with external interface as defined in this specification.

xv. Planning, deployment & tuning of communication systems to meet the performance requirements as specified in the bidding document

xvi. **Cloud Service Provider (CSP) Requirements**

   I. Bidder may partner or appoint as a sub-contractor a local party in India to provide Cloud services for the RF Mesh Canopy solution as per clause 3.8.
   II. CSP should also carry out cloud Hosting of Applications and its maintenance for the Project period as well as provide connectivity of Cloud to HPSEB's Data Center for Data Exchange
   III. The Contractor shall also bear the cost of recurring charges for, Bandwidth and Cloud Hosting Charges till completion of Maintenance Support period.

xvii. Deployment of suitable backend communication technology (GPRS, Radio, Leased Line etc.) may be considered for data communication to HES. However, cellular connectivity may be checked before deployment. GPRS SIM cards shall be provided by the contractor in the name of utility for which necessary support shall be provided by utility. Service Level Agreement with service providers shall be done by contractor and it is the responsibility of the contractor to ensure the SLAs defined in section 4 are met.

xviii. Develop an overall AMI Architecture capable of upgrades and scaling out as per future requirements

xix. Installation of additional equipment to account for additional consumers during maintenance period

xx. Generation of analytics reports as detailed in section 3.7.11 to aid in decision making at various levels of utility

xxi. **Baseline Study and formulation of DPR**

    a. The Contractor shall carry out a baseline study to identify the targets and establish Key Performance Indicators (KPIs) for measuring benefits of the AMI Project

    b. The Contractor shall carry out complete site survey of HPSEB site to prepare the DPR as per the site conditions of HPSEB

    c. The Contractor shall carry out complete site survey of HPSEBL site for the communication system requirements

    d. "As Is" study of existing IT systems prevalent at the HPSEB and do a gap analysis w.r.t. the AMI system to be implemented and submit "To be" report for IT system consolidation for ensuring full benefits of AMI

    e. The Contractor shall prepare Detailed Project Report (DPR) which would include narrative description of the project objective and rationale for its deployment, technical feasibility study, overall architecture and operational philosophy of the proposed AMI solution and methodology for achieving different functionalities, specified in this document and also highlight additional features, if any, financial projections, detailed cost benefit analysis, proposed cost recovery mechanism, implementation approach & methodology, project implementation schedule, performance incentives if any, monitoring, verification and evaluation plan, consumer engagement plan, governance framework, training and capacity building plan

xxii. **Project Implementation & Monitoring**

    a. Preparation and submission of Project Implementation Plan in consultation with PFCCL/ HPSEB

    b. Carrying out performance tests like Factory Acceptance Test (FAT), Site Acceptance Test (SAT) etc. and inspection of the installed infrastructure jointly with PFCCL/ HPSEBL team

    c. Ensure implementation of the governance mechanism, and submit Monthly Progress Reports on AMI Project implementation

    d. Ensuring Operational Acceptance

    e. Providing Installation Record/ Certificate to PFCCL/ HPSEBL indicating the date of installation, serial number, capacity and make of the AMI Infrastructure, the installation date and service dates etc.

    f. Submission of checklist of documents wherein HPSEB approvals are required

    g. Submission of all deliverables to HPSEB and incorporation of suggestions/ comments, if any

xxiii. **Training & Development –** Providing **t**raining of identified personnel of PFCCL and HPSEB on operation and maintenance of AMI Infrastructure (at least 2 times a year during first 3 years for 6 persons per batch)

xxiv. **Operation & Maintenance (O&M) Services** - Post establishment of AMI Infrastructure, Facility Management Services (FMS) / Operation & Maintenance (O&M) Services would be provided for a period of seven (7) as per Service Level Agreements (SLA) agreed with

PFCCL/ HPSEB and handover of AMI System to HPSEB after completion. The services would include the following:

a. Management and maintenance of complete AMI system for the contract duration i.e. till completion of operation and maintenance phase.
b. Management of Cloud platform, IT Licences renewal, IT Software maintenance.
c. Management and Maintenance of all the hardware supplied in the project for the contract duration i.e. till completion of operation and maintenance phase.
d. Connectivity and Communication of AMI project
e. Maintaining system availability/ uptime as per agreed SLA.
f. Maintenance of entire AMI field & Back-End Infrastructure.
g. Maintenance of AMI RF / Hybrid Network.
h. Installation of Smart Meters for new connections, disconnection & replacement of faulty meter on request of HPSEB.
i. Smart Metering Control Centre operation & maintenance.
j. Identification and reporting of exceptional cases based on MDMS data analytics as per the agreed measurement & verification methodology.
k. Providing recommendations and improvement measures.
l. Review, analysis & validation of AMI Project results linked to KPIs.
m. Energy Audit report, Data Analytics for eliminating pilferage of Power & assistance in 'recovery measures' in collaboration with PFCCL/ HPSEB.
n. Managing projects issues and concerns.
o. Transfer of the ownership, rights and title of the installed AMI Infrastructure to the HPSEBL post completion of the FMS/ O&M period.
p. Implementation of Consumer Engagement Plan and ensuring effective redressal to the consumer grievances and complaints.
q. Action for rectification of faults in AMI system as per system inputs.
r. Highlighting projects issues and concerns; providing recommendations for corrective actions

xxv. **Assisting HPSEBL in adoption of AMI:** As implementation of AMI will need HPSEB to adopt to the changes which is expected to be implemented on selected consumer base in a phased manner. The Contractor will assist PFCCL/ HPSEB in the following areas to ensure smoother adoption and usage of technology:

a. **Regulatory Representations and Approvals:** AMI shall enable HPSEB to offer services like remote connect/ disconnect, peak load reduction, Time of Day tariffs etc. The Contractor will assist PFCCL/ HPSEB officials to facilitate regulatory approvals while offering various services to customers

b. **Restructuring of Organization Structure:** HPSEB shall need to make necessary changes in the current organization structure to ensure smooth adoption and operations. The Contractor shall assist the HPSEB in formulation of best organizational structure and creation of sufficient team for the project keeping in view the future roll out of Smart Meters

c. **Business Process Re-engineering:** Contractor shall do an in depth study of commercial processes of HPSEB to form an understanding of "As-Is" processes being carried out. Based on this understanding a gap analysis shall be done with

respect to requirements post deployment of new AMI systems & necessary recommendations for making suitable changes in processes shall be made to HPSEB.

d. **Integration Services:** Smooth operations of AMI and usage of full functionalities offered by AMI shall require its integration with many existing systems as well as planned future technology deployments**.** The Contractor shall assist HPSEB engineers in identification of use cases for integration of AMI with other systems. The Contractor will integrate AMI system with existing application/systems of HPSEB as per HPSEB's requirement and also facilitate for integration of AMI system with future system/applications of HPSEB.

e. **Customer Engagement:** Smart meter roll out success depends to a large extent depends upon its acceptance by the end customers. The Contractor will assist HPSEB officials in managing customer engagement and reach out program which shall enable smooth roll out of the smart metering project.

f. **Employee Competency Building:** During O&M phase the Contractor shall assist PFCCL in designing training programs and conduct training programs which shall enable utility officials to operate and maintain the AMI system on their own

g. **Consolidation of IT Systems for Optimization:** The Contractor shall do a "As Is" study of existing IT systems prevalent at the HPSEB and do a gap analysis w.r.t. the AMI system to be implemented. Finally the Contractor shall share a "To be" report for IT system consolidation for ensuring full benefits of AMI

xxvi. To provide remote console facility at Shimla and Dharamshala for monitoring and other operational functions of Smart Meters in their respective area.

xxvii. The Contractor shall establish the Back-End IT system with scalability features to handle all HPSEB consumers i.e. consumers of HPSEB in entire State of H.P. for next 15 years.

xxviii. **Smart Meters proposed _should have the provision of Pre-paid mode also_** and can be configured from the back office from post-paid to pre-paid and vice versa. PFCCL's Back-End IT System and deployment approach should have the provision to configure a set of Smart Meters to Pre-paid mode as per HPSEBL's need. The Smart Meters with Pre-paid option should provide the following facilities to the HPSEBL over the Conventional pre-paid metering system:

a. Credit Updation from remote
b. Revenue Protection (Tamper) Monitoring
c. Remote Tariff Rate and Slab Updation
d. Proper and Regular Energy Accounting and Auditing.
e. Last gasp and First Breathe with Outage Management System.
f. Peak Load Management and Demand Response support.
g. Manpower saving in coupon insertion.
h. Detection of faulty or Burnt Meters.
i. Real Time Tamper Alerts, Alarm/ Notification and acknowledgement.
j. Integration for pre-payment recharge coupon with existing billing application of HPSEB.

xxix. **Repair & Maintenance of installed AMI Infrastructure**

a. Action for rectification of faults in AMI system as per system inputs.

b. In case of any faulty/ malfunctioning in AMI Infrastructure, PFCCL/ HPSEB to provide details of the fault/ malfunction or the reason of failure and submit a copy of the Installation Record/ Certificate.

c. Verification of the fault/ reason for failure of the AMI Infrastructure by a Third Party Agency or Joint Team of the Contractor, PFCCL and HPSEB executives, as per requirement, and intimation of the findings to PFCCL and HPSEB;

d. Ensuring that faulty or defective AMI Infrastructure is repaired or replaced as soon as reasonably feasible and free of cost to the HPSEB. A record of the repairs/ replacements of the AMI Infrastructure to be kept and shared with PFCCL/ HPSEB on quarterly basis;

e. In case of any theft or sabotage of the AMI Infrastructure or if the reason(s) for failure/ malfunctioning or defect of the AMI Infrastructure is attributable to normal wear and tear, or mishandling or inappropriate usage of the AMI Infrastructure by the HPSEB, or reasons attributable to the negligence of the HPSEB, the Contractor will ensure replacement of same and cost will be borne by HPSEB/ PFCCL as per the price discovered through this tendering process.

xxx. Any other services as may be required by PFCCL/ HPSEB & mutually agreed upon.

1.4.2   The detailed BOQ is given in Annexure E. The Bidder has to carry out the detailed survey and collect the required data. All other associated works/items described in the Technical Specifications for a viable and fully functional system is the responsibility of Bidders.

1.4.3   The contractor shall have to maintain the system for Seven (7) years after operational acceptance by HPSEB. During the seven years of maintenance, Contractor shall maintain system availability as mentioned in this document. Contractor shall also maintain necessary spares such as smart meters, routers, etc. to attend problems during maintenance of the system. During maintenance period, contractor shall maintain the service level as explained in this Technical Specifications. The Contractor shall also bear the cost of recurring charges for GPRS/3G/4G, static ISP connection and any license fee for operating RF in licensed frequency band till completion of maintenance period.

1.4.4 Comprehensive warranty should be provided for the system, by the contractor(s), for 5 years after operational acceptance of the AMI system by PFCCL/ HPSEB and for the balance period (post warranty) during Engagement of the Contractor, the Contractor shall provide Annual Maintenance Support to PFCCL/ HPSEB.

1.4.5 Deleted

1.4.6 This RFP is being floated by PFCCL on behalf of HPSEB to appoint a contractor for Supply, Implementation Testing, Commissioning & FMS for implementation of Smart Metering in Shimla and Dharamsala City in Himachal Pradesh.

2. General Requirements

2.1 General Responsibilities and Obligations

2.1.1 Bidders must conform to requirements and provide a list of equipment (including any special equipment) necessary to meet the functional & performance requirements stated herein. It should be noted that preliminary design information and Bill of Quantity (BoQ) specified in this specifications are indicative only except the quantities of smart meters. The Bidders shall verify the design data during the site surveys & detail engineering and finalize the BOQ as required for ultimate system design & development to meet performance requirements.

2.1.2 Bidder shall submit Clause by Clause compliance to the Technical Specifications (forming part of RFP Document read in conjunction with amendments, if any. Deviation if any shall be clearly mentioned.

2.1.3 The bidder's proposal shall address all functional and performance requirements within this specification and shall include sufficient information and supporting documentation in order to determine compliance with this specification without further necessity for inquiries.

2.1.4 Bidder may provide all applications in one suite or multiple modules to meet all the Technical Specification requirements. The bidder's proposal shall clearly identify all features described in the specifications or in any supporting reference material that will not be implemented; otherwise, those features shall become binding as part of the final contract.

2.1.5 An analysis of functional and performance requirements of this specification and/ or site surveys, design, and engineering may lead Bidders to conclude that additional items (for example communication repeater, router etc.) are required that are not specifically mentioned in this specification. Bidders shall be responsible for providing at no added cost to the Employer, all such additional items such that a viable and fully functional AMI system is implemented that meets or exceed the capacity and performance requirements specified. Such materials shall be considered to be within the scope of the contract. To the extent possible, the bidder shall identify and include all such additional items in their proposal.

2.1.6 The offered items shall be designed to operate in varying environments. Adequate measures shall be taken to provide protection against contaminants, pollutants, rain water & moisture, lightning & short circuit, vibration and electro-magnetic interference etc. The Bidders shall demonstrate a specified level of performance of the offered items during well- structured factory and field tests.

2.1.7 All equipment provided shall be designed to interface with other equipment and shall be supporting all present requirements and spare capacity requirement identified in the Technical Specifications.

2.1.8 The Bidders are advised to visit sites (at their own expense), prior to the submission of the proposal, and make surveys and assessments as deemed necessary for proposal submission. The successful Bidder (Contractor) shall be required to visit project area for detailed site surveys for performing the design and implementation functions.

2.1.9 After the site survey the Contractor shall submit a survey report. This report shall include at least the following items (however, the exact parameter for survey & format of the survey report shall be finalized by the Contractor with the approval of PFCCL/ HPSEB):

a. Proposed routing of power, earthing, communication signal cables including trenches etc.
b. Tentative location of devices/equipment for setting up communication network.
c. Consumer indexing of the project area (mapping of consumers (including their GPS coordinates) with DTs and Feeder)
d. Confirmation of adequacy of space and AC power supply requirements.
e. Identify all additional items required for interconnection with the existing/owner provided equipment/facilities
f. Verification of all integrations with external systems as mentioned in the RFP
g. Requirement of modification to existing earthing arrangement of control centre and locations where communication equipment / devices etc. are to be installed, if any

2.2   Access to Utility Facilities

2.2.1   PFCCL to facilitate through HPSEB management, safe and reasonable access to utility premises for contractor's personnel and third party vendors. This facilitation shall include, space for data centers, working space including air conditioning, light, ventilation, electric power and outlets. The contractor's personnel shall comply with all applicable rules, regulations and requirements relating to visitors on the premises of HPSEB.

2.3   Responsibilities for the Implementation Plan

2.3.1   The bidder's technical proposal shall include a project implementation plan and schedule spread over 20 months from date of commencement that is consistent with the implementation plan detailed in this specification. The Implementation plan shall include the activities of both the Bidders and PFCCL/ HPSEB, showing all key milestones and clearly identifying the nature of all information and project support expected from the PFCCL/ HPSEB. PFCCL/ HPSEB and Bidders together shall finalize the detailed implementation plan following award of the contract.

2.4   Contractor's Responsibilities and Obligations

2.4.1   Contractor's obligations include, but are not limited to, the following (as well as in clause 1.4):

1)   To provide a working system that meets or exceeds the functional and performance requirements of this specification without affecting the operation of the existing systems.
2)   To perform equipment engineering and design specific to each location including review of, and conformance with local environmental and earthing considerations.
3)   Installation of field devices, hardware, software and communication system.
4)   To FMSdevelop O&M guidelines.
5)   Overall integration of equipment/subsystem as defined in this RFP document
6)   Integration of new Meters
7)   Sharing of relevant interface details at DCU, HES and MDM layers
8)   Achieving interoperability for AMI through incorporation of the communication modules (NICs) inside the Smart meters of any make of Smart meters as short listed by utility for this project area in the future.
9)   Identifying, buying and maintenance of spares under AMC along with main items to ensure system availability during installation and maintenance period.

10) Project management, project scheduling, including periodic project reports (weekly/monthly basis) documenting progress during the contract period.

11) To provide engineering and technical assistance during the contract warranty and maintenance period.

12) Updation of consumer indexing in the AMI system during the installation and maintenance period

13) To identify all additional Equipment and services necessary to ensure compatibility between new and existing equipment.

14) To implement all minor civil works necessary for installation of proposed equipment and provide the details of such work to PFCCL/ HPSEB.

15) To define source power requirements for each cabinet/ rack of equipment provided and the total power requirements to run the system

16) To ensure that all the required hardware, software, and firmware satisfy the requirements of this specification and are suitable for future scaling, optionally with upgrades.

17) To conduct factory and site acceptance testing of all hardware, software and firmware provided

18) Conduct type tests or provide documented evidence of type testing and BIS certification to the PFCCL/ HPSEB as sought in specifications.

19) To provide a Quality Assurance Plan and access to manufacturing process, as required.

20) Shipment of all equipment to designated locations and/or storing areas.

21) To provide storing, maintenance of storing area and security including full responsibility for protection from theft and fire for all the items to be supplied. The warehouse may be a temporary storage area to be constructed by contractor. Space for material storage would be provided by HPSEB at no extra cost for storing the supplied equipment in respective areas where project work is in progress.

22) Prepare and submit all documentation and drawings in hard copy as well as soft copy.

23) Supply all required spare parts, maintenance aids, and test equipment, software maintenance and testing tools

24) Training of the PFCCL/ HPSEB personnel.

25) Hardware, software, and firmware maintenance, debugging, and support of the software applications, and maintenance of all supplied equipment.

26) To provide full backup of all installed software applications and data.

27) To test restoration of the system from the backup provided.

28) Availability of service, spare and expansion parts for the supplied items for the complete design life i.e. 7 years from the operational acceptance of the system as per details in various parts of this specification.

29) Auxiliary Power Supply comprising of UPS for 8 hours battery backup along with all necessary distribution.

30) Assistance in development & implementation of consumer engagement plan

2.4.2 Detailed descriptions of the Contractor's obligations, in relation to individual items and services offered, are delineated in other sections of this specification.

2.5   Exclusion from Contractor's Scope

2.5.1 Following shall be excluded from Contractor's scope:
a. Construction of building for AMI Control Centre

    b. Interior and IBMS (Integrated Building Management System) of building for AMI Control Centre

    c. A.C. input power supply for AMI Control Centre

2.6 Employer/ Utility's Responsibilities and Obligations

2.6.1 PFCCL in coordination with HPSEB will provide following items and services as part of this Project:

1) Review & approval of Contractor's designs, drawings, survey reports and recommendations.
2) Review and approval of test procedures.
3) Participation in and approval of "Type", factory and site acceptance tests.
4) Review and approval of training plans & reading material
5) Providing support and access to facilities at the sites, including consumer premises.
6) Arranging necessary shutdowns and work permits.
7) Implement the major civil works such as expansions or construction of rooms, trenches etc. as required for the equipment to be provided by the Contractor.
8) Provide to the extent possible drawings for AMI Control Centre building where equipment installations are planned.
9) Obtaining requisite statutory clearances and/or approvals as required to be taken by HPSEB for project work.
10) Providing available details of the consumer indexing and informing the contractor of any changes in the area network during the project installation and maintenance period
11) Providing A.C. power supply inputs as defined in this specification
12) Provide equipment storage space
13) All required documents for delivery of material at site
14) Travel expenses of employer's representative during training & testing
15) Regulatory support/changes as required
16) Approvals/Suggestions for change in submitted documents/ reports to be given to contractor in time bound manner.
17) Development & implementation of consumer engagement plan
18) Overall project management
19) Organize project review meetings
20) Releasing funds to contractor as per agreed terms of Payment.

2.7 General Bidding Requirements

2.7.1 The Bidder shall be responsive to the technical requirements as set forth in this specification. The bidder's proposal shall include the compliance for Technical Proposal including the documents listed in the Table below shall be provided in the bid.

S. No	Description	Enclosure Reference	
1.	Details of the supplied hardware	Page no. Ref no.	
2.	System Sizing Requirements Annexure-G	Page no. Ref no.	
3.	Quality Assurance Program (As per Quality Assurance of Technical Specification Volume II)	Page no. Ref no.	
4.	Detailed project implementation plan (As per Technical Specification Volume II).	Page no. Ref no.	
5.	Approach paper for implementation	Page no. Ref no.	

S. No	Description	Enclosure Reference	
6.	Schematic Diagram of Proposed System Configuration	Page no. Ref no.	
7.	Overall system architecture capable of scaling out	Page no. Ref no.	
8	Table of Compliance (As per Annexure-D)	Page no. Ref no.	

2.7.2   A detailed project implementation plan and schedule that is consistent with the scope of the project and HPSEB's specified objectives shall be provided. The plan shall include the activities of the Bidders, PFCCL/ HPSEB, show all key milestones and clearly identify the nature of all information and project support to be provided by PFCCL/ HPSEB.

2.7.3   A commitment and a clearly defined plan to develop a system support organization, based in India and capable of providing a full range of local services (including software and hardware maintenance and upgrade support) for the life of the delivered systems.

2.7.4   The bidder may offer the bought-out items from more than one manufacturer.

2.8   Applicable Standards

2.8.1   Specifications and codes shall be the latest version, inclusive of revisions, which are in force at the date of the contract award. Where new specifications, codes and revisions are issued during the period of the contract, the Bidders shall attempt to comply with such, provided that no additional expenses are charged to the Employer without Employer's written consent.

2.8.2   In the event the bidder offers to supply material and/or equipment in compliance to any other international standard other than Standards listed in the document, the Bidders shall include with their proposal, full salient features of the new standard for comparison.

2.8.3   In case values indicated for certain parameters in the specifications are more stringent than those specified by the standards, the specification shall override the standards.

2.9   Technical Obsolescence

2.9.1   The systems which are at a risk of technical obsolescence over the operating life of the system should be identified; this should include end-of-sale and end-of-support policies governing the proposed technologies. Forward and backward compatibility need to be considered and mitigation option shall be indicated in detail and shall not be limited to periodic update from OEM/System supplier

3. AMI Specifications

3.1   AMI Functional Requirement

3.1.1   AMI shall include Smart meters, communication systems, routers/ access point/ DCU, customer associated systems, Head End System (HES)/ Meter Data Acquisition System (MDAS), Meter Data Management (MDM) software, and business analytics.

3.1.2   The main objective of AMI is to enable two way communication between smart energy meter and Head End System (HES) to enable remote reading, monitoring & control of electrical energy meters (consumer, feeder, DT meters etc.) to serve as repository of record for all raw, validated and edited data. The sanitized data may be subscribed by other utility function for higher order analysis and billing and collection engine etc.

3.1.3   The AMI system shall help utility to manage their resource and business process efficiently. AMI system shall support the following minimum functionalities:

(i)   Remote Meter data reading at configurable intervals(push/pull)

(ii)   Time of day (TOD)/TOU metering

(iii)   Pre-paid functionality

(iv)   Net Metering/Billing

(v)   Alarm/Event detection, notification and reporting

(vi)   Remote Load Limiter and connection/ disconnection at defined/on demand conditions

(vii)   Remote firmware upgrade

(viii)   Integration with other existing systems as defined in this document

(ix)   Import of legacy data from existing modules/ MDAS of RAPDRP where ever possible. The extent and modalities of integration with the existing system including RAPDRP has to be worked out by the bidder.

(x)   Security features to prevent unauthorized access to the AMI including Smart meter & meter data etc. and to ensure authentication of all AMI elements by third party.

(xi)   This is only an indicative but not exhaustive list. The system should be capable to support the other functionalities as per the requirement of utilities.

(xii)   The System will accurately maintain system time synchronization across all devices to ensure accuracy of data. The system should support the interfacing with the future Smart Grid functionalities like peak load management, outage management system, distribution automation including self-healing system, GIS, distribution transformer monitoring units, Electric vehicle, distributed energy resources etc.

(xiii)   Communication network shall preferably be able to support multiple applications.

3.1.4 The Bidder shall submit an approach paper describing overall architecture and operational philosophy of the proposed AMI solution and methodology for achieving different functionalities, specified in this document and also highlight additional features, if any.

3.2 General AMI System Requirement

3.2.1 Smart Meter (Single phase whole current, Three phase whole current, CT & PT operated three phase meters and CT operated three phase meters) for consumers/ system shall be provided based on Radio Frequency (RF) mesh in Licensed frequency band as permitted by WPC or in Unlicensed frequency band (Wherever RF is not feasible GPRS based communication shall be established) for communication of data between field equipment/ smart meters. Cloud services shall be established as per the specifications mentioned in this document and to ensure the performance level given in this document to cover towns of HPSEB for congested/ highly populated areas. The network would provide a medium for two-way communication between various nodes & Head End System (HES). Different nodes shall interconnect with each other using RF mesh network and they shall communicate with nearby routers to transfer the data to access points/ HES. The contractor shall ensure proper data exchange among Smart meter, router/ access points/ DCU, MDM, HES and other operational/requisite software as part of fully functional AMI system.

3.2.2 Contractor shall adhere with appropriate security algorithm for encryption & decryption. For smooth functioning of entire system, it is essential that the details of such algorithm including the mechanism of security key generation be kept in a secured escrow account which shall be used by the utility only in case of termination of the contract for reasons whatsoever.

3.2.3 Contractor may design appropriate architecture for providing end to end metering solution. Contractor is free to decide upon the best solution out of all the available options. However, the entire responsibility of fully functional AMI system shall rest with the contractor in order to meet the performance levels as given in this document. The communication provider may adopt Radio Frequency (RF) mesh in licensed frequency band as permitted by WPC or in Unlicensed frequency band or RF based canopy system (Wherever RF is not feasible GPRS based communication shall be established) or a combination of these technologies as per the site requirement adopting best available technology in the proposed area of implementation.

3.2.4 The following core components of AMI system shall be provided:

    a) Smart Meters
    b) Communication infrastructure
    c) Head End System(HES)
    d) Meter Data Management System (MDM)
    e) Web application with updated on-line data of consumers etc.
    f) IT Infrastructure over cloud to host the HES, MDM and Web Applications
    g) Mobile app: Bidder shall provide a mobile app through which consumer shall be able to log in through android/iOS/Window based mobile app to see information related to his/her energy consumption. App shall also provide platform for implementation of peak load management functionality by providing existing tariff & incentives rates, participation options etc. Features in this app which relates to demand response should be treated as provisions for future integration. This mobile app shall be part of complete system and therefore no additional cost shall be payable for upgradation / maintenance separately.

3.3   Smart Meters

Single Phase & Three Phase whole current smart meters shall comply with IS 16444 (latest version) .Three Phase CT operated meter shall comply IS 16444: Part 2. The contractor has to furnish valid BIS certification before supply of meters.

After meter installation, customer identification no., meter ID, its hardware & software configuration, name plate details, make, type i.e. 1 Phase or 3 Phase shall be updated in DCU/HES/MDM. The information would also be updated on the portal/app for providing information to consumers.

The Basic Features of Smart Meter shall be:

   a. Measurement of electrical energy parameters
   b. Bidirectional Communication
   c. Integrated Load limiting switch
   d. Tamper event detection, recording and reporting
   e. Power event alarms such as loss of supply, low/ high voltage, out of band frequency
   f. Remote firmware upgrade
   g. Remote configuration change form post-paid to prepaid or net metering or vice a versa
   h. Time of Use (ToU) tariff
   i. Net metering features (for smart meters with Net-metering feature)
   j. On demand reading

3.3.1   Whole Current A.C. Single Phase Two Wire Smart Energy Meter Of Accuracy Class 1.0 (with/ without net-metering)

3.3.1.1 Smart Meter shall be an A.C. static-watt hour meter of accuracy class 1 for the measurement of alternating current electrical active energy of frequency 50 Hz, with time of use registers, internal connect and disconnect switches with two way communication capability. The bi- directional communication module can either be of built in type or plug-in type with suitable sealing arrangement. The meters with net-metering facility shall measure flow of both forward (import) and reverse (export) energies.

3.3.1.2 The single phase whole current Smart Meter shall conform to the standards and specification as specified in Annexure A

3.3.2   Whole Current A.C. Three Phase Four Wire Smart Energy Meter Of Accuracy Class 1.0 (with/ without net-metering)

3.3.2.1 Smart Meter shall be an A.C. static-watt hour meter of accuracy class 1 for the measurement of alternating current electrical active energy of frequency 50 Hz, with time of use registers, internal connect and disconnect switches with two way communication capability. The bi- directional communication module can either be of built in type or plug-in type with suitable sealing arrangement. The meters with net-metering facility shall measure flow of both forward (import) and reverse (export) energies.

3.3.2.2 The three phase whole current Smart Meter shall conform to the standards and specification as specified in Annexure B

3.3.3   Three phase CT operated alternating current smart meter Of Accuracy Class 0.5S

3.3.3.1 Three phase CT operated alternating current smart meter shall be four wire smart energy meter of accuracy class 0.5S with two way communication facility. The bi-directional communication module can either be of built in type or plug-in type with suitable sealing arrangement. The meters with net-metering facility shall measure flow of both forward (import) and reverse (export) energies.

3.3.3.2 The three phase CT operated Smart Meter shall conform to the standards and specification as specified in Annexure C

3.3.4 Tests

3.3.4.1 Type tests and test certificates

3.3.4.1.1 Single phase and three phase whole current Smart meter shall be type tested for all the type tests as per IS: 16444 (latest version) and three phase CT operated Smart Meter hall be type tested for all the type tests as per IS: 16444 Part-2 (latest version) in a government approved laboratory. The number of sampling for testing of meters and criteria for conformity would be as per IS 16444 and IS 16444 Part-2. The supplier shall have to submit all type test certificates along with the bid.

3.3.4.1.2 Type test should not be older than 3 years. Without above type test certificate the offer shall not be considered. Employer reserves right to select randomly one meter from offered lots for inspection for its type test and if meter during type test is found failed then either the order placed shall be cancelled with Contractor to collect all meters at its cost for the supplied meters or Contractor shall have to replace all supplied meters at their cost after manufactured and successful type test within time frame given by the Employer.

3.3.4.1.3 Routine and Acceptance Test

3.3.4.1.1 The Factory Acceptance and Routine tests shall be carried out as per IS 16444 and IS 16444 Part-2. Apart from above test, meter shall be also be tested for all functional requirement through communication as part of acceptance test

3.3.5 General and Constructional Requirements for Meters

a. Meter shall be BIS marked as per IS 16444/ / IS 16444 Part-2.

b. General & construction requirement shall be as per IS 16444/ IS 13779/ IS 16444 Part-2

c. In Home Display (IHD) shall be optional and the specifications of the same would be as per agreement between the bidder and the utility.

3.3.5.1 Meter Base and Cover

3.3.5.1.1 Meter base & cover shall be as per IS 16444/ IS 13779/ IS 16444 Part-2. The meter Base & cover shall be break to open design. The material for meter base and cover shall be made of high grade polycarbonate.

3.3.5.2 Terminal Block and Cover

3.3.5.2.1 As per IS 16444/IS 13779/ IS 16444 Part-2

3.3.5.3 Design

3.3.5.3.1 Voltage circuit, sealing arrangement, terminal block, terminal cover and nameplate etc. shall be in accordance with IS-16444 (latest version).

3.3.5.3.2 The meter shall be compact and reliable in design, easy to transport and immune to vibration and shock involved in transportation and handling.

3.3.5.4 Circuitry

3.3.5.4.1 As per IS 16444/ IS 16444 Part-2. The contractor shall submit the details of source/agencies from whom purchase of various components of meters have been made by them by them to the employer

3.3.5.5 Name Plate and Marking

3.3.5.5.1 The meter should bear a name plate clearly visible, effectively secured against removal and indelibly/distinctly marked in accordance with relevant IS. In addition, in the middle of the name plate the words Himachal Pradesh State Electricity Board Ltd., purchase order no. & year/month of manufacturing shall either be punched or marked indelibly. The rating plate information shall be as per relevant IS.

3.3.5.6 Connection Diagram

3.3.5.6.1 As per IS 16444/ IS 16444 Part-2

3.3.5.7 Fixing Arrangement

3.3.5.7.1 The meter shall be mounted type. The Meter should have three fixing holes, one at top and two at bottom. The Top hole should be such that the holding screw is not accessible to the consumer after fixing the meters. The lower screws should be provided under sealable terminal cover. The requisite fixing screws shall be supplied with each meter.

3.3.5.8 Sealing Arrangement

3.3.5.8.1 Arrangements shall be provided for proper sealing of the meter cover so that access to the working parts shall not be possible without breaking the seal.

3.3.5.8.2 Sealing arrangement & number of seals shall be as per relevant IS/ requirement of utility.

3.3.5.9 Meter Box

3.3.5.9.1 The Meter Box would be provided as per latest standards and requirement of HPSEB.

3.3.5.10 Packing

3.3.5.10.1 The meters shall be suitably packed for vertical/horizontal support to withstand handling during transportation. The meter shall be packed appropriately to ensure safe transportation, handling, identification and storage. All packing materials shall be as per environment law in force. The primary packing shall ensure protection against humidity, dust, grease and safeguard the meter's performance until its installation. The secondary packing shall provide protection during transportation. The packing case shall indicate

"Fragile in nature" and direction of placement of box. Each packing shall indicate marking details like Manufacturer's name, S.No. of meters, quantity etc.

3.3.5.11 Transportation

3.3.5.11.1 The meter shall be compact in design. The meter block unit 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.

3.3.5.11.2 The meter should not be exposed to undue shock and mishandling during transportation. The stacking of box inside transport media should be such as to avoid their free movement. The packing should also be protected from rain and dust by transport media. The Bidder shall be responsible for any damage during transit due to inadequate or improper packing.

3.3.5.12 Testing and Manufacturing Facilities

3.3.5.12.1 The manufacturer shall have NABL accredited laboratory to ensure accurate testing calibration as per IS 16444/ IS 13779/ 16444 Part-2 for acceptance test.

3.3.5.13 Inspection

3.3.5.13.1 All meters shall be duly tested and sealed by the firm at their premises prior to inspection. Manufacturer seal may be provided on one side of meter. For the other side, the seal with engrave as Himachal Pradesh State Electricity Board Ltd. may be sent in a pack for provision by HBSEB after completion of test by HPSEB & after receipt of the meter.

3.3.5.13.2 The HPSEB/ PFCCL may select the meter randomly as per sampling plan for acceptance test as per IS 16444/ IS 16444 Part-2. The meters shall be tested for all functional requirements as part of acceptance test as per IS 16444/ IS 16444 Part-2. After testing, these sample meters shall be additionally sealed by the inspecting officer and one copy of the inspection report will be handed over to the manufacturer.

3.4 Communication Infrastructure

a. The communication infrastructure shall be based on RF mesh network in combination with cellular network.

b. The communication network shall be based on suitable standards from ITU/ IEC/ IEEE/ CEN/ CENELEC/ ETSI for NAN and WAN network.

c. Communication network shall provide reliable medium for two-way communication between various nodes (smart meter) & HES.

d. RF based network shall use Unlicensed or Licensed frequency band as permitted by WPC.

e. In this type of communication network, different nodes (smart meters) shall interconnect with each other using RF mesh network and they shall communicate with nearby routers to transfer the data to access points.

f. In such communication network, if any routers/repeaters/access points fail, then nodes connected on that device shall automatically reconfigure the mesh with available nearby nodes.

g. The general functionalities for the Router based RF network are specified below:
   i. The communication network shall have dynamic & self-healing capability. If one of the communication element like router or access point fails then nodes connecting to that element shall switch to best available element for communication of data to HES.
   ii. It shall support IPv4 / IPv6 network addressing.
   iii. Each node shall keep a track of best available nearby nodes.
   iv. The communication network equipment shall use Unlicensed or Licensed frequency band as permitted by WPC.
   v. All the communication network equipment shall be certified by WPC, Government of India for operation in license free frequency band.
   vi. The engagement of network service provider would be in the scope of Contractor to meet the performance level as given in the document.
   vii. Suitable network management system (NMS) shall be available to monitor the performance of the communication network round the clock. The NMS shall provide viewing of all the networking elements deployed at site and enable configuration, parameterization of the networking devices and the nodes.
   viii. It shall support remote firmware upgrading
   ix. It shall be secure enough to avoid all cyber threats like DDoS, spoofing, malwares etc.
   x. The communication network shall ensure secure communication of data to HES.
   xi. The equipment shall be weatherproof, dustproof and constructed for outdoor installation on poles (minimum rating: IP-55). A suitable mounting provision shall be made for the equipment.
   xii. Enclosure: Provision for security sealing shall be provided and in case the gasket of the cover is used for protection against moisture, dust and insects, the gasket shall be made of weather and aging resistant material.
   xiii. Routers / Access Points shall have suitable power supply arrangements. Provision of battery backup for at least 5 hour shall be there to continue operation in case of power supply failure. The life expectancy of battery shall be 5 years or more.

3.4.1   General Requirements

3.4.1.1 The bidder shall design reliable, interference free & robust communication network. It shall be flexible in terms of providing communication in variable terrain & urban density.

3.4.1.2 The bidder shall design the network architecture keeping in view the existing and planned infrastructure of the utility. During designing, suitable consideration shall be kept for future expansion as per requirement of Utility. Before designing the communication network, the bidder shall do the site survey and would provide the most efficient communication infrastructure.

3.4.1.3 The entire infrastructure & associated civil works required for installation & commissioning of equipment/devices like DCUs, repeaters, routers & access points etc. shall be in the scope of bidder. The operational testing of all the network elements has to be demonstrated by the bidder to the satisfaction of the utility.

3.4.1.4 The network solution offered by the bidder should have disaster recovery mechanism in place. The redundancy mechanism of HES and MDM and their disaster recovery plan shall also be described by the Bidder.

3.4.1.5 The quality of installation of the various equipment & power supply wiring to all field equipment shall be as per standards/ regulations/prevailing practices of the utility. The supply of electricity needed for operation and maintenance of entire AMI system shall be the provided by the utility free of cost.

3.4.1.6 A suitable network management system (NMS) shall be provided to monitor the performance of the communication network round the clock. The NMS shall provide viewing of all the networking elements deployed at site and enable configuration & parameterization of the networking devices and the nodes.

3.4.2 Network Security

3.4.2.1 The Network shall have adequate cyber security measures not limited to the measures as described below. The network security would be extended to all the interfaces also.

    a. **Secure Access Controls**: The system shall include mechanisms for defining and controlling user access to the operating system environment and applications. Best practices from enterprise security including password strength, password aging, password history, reuse prevention etc. must be followed for access control.

    b. **Authorization Controls**: A least-privilege concept such that users are only allowed to use or access functions for which they have been given authorization shall be available.

    c. **Logging**: Logs must be maintained for all attempts to log on (both successful and unsuccessful), any privilege change requests (both successful and unsuccessful), user actions affecting security (such as password changes), attempts to perform actions not authorized by the authorization controls, all configuration changes etc. Additionally, the access to such logs must be controlled in accordance to the least-privilege concept mentioned above, so that entries may not be deleted, accidentally or maliciously.

    d. **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.

    e. **Malicious Software Prevention**: Implementation of anti-virus software and other malicious software prevention tools shall be supported for all applications, servers, data bases etc.

    f. **Network Security**: The network architecture of the HES must be secure with support for firewalls and encryption. The system shall also allow host-based firewalls to be configured, as an additional layer of security if the network firewall were to fail.

3.4.3   Communication Network Elements

The Bidder may either use Data Concentrator Unit (DCU) based Communication Network or Router based RF Mesh Network.

3.4.3.1   Data Concentrator Unit (DCU) based Communication Network

The Data Concentrator Unit is a gateway for communication of data between the Smart Meters and the HES. The Data Concentrator Unit receives information from the Smart Meter on a scheduled / need basis and stores the data, which can be accessed by HES for onward transfer to MDM.

The DCU provides the central link between Smart Meters and HES, enabling continuous/periodic meter read and control. DCU shall exchange data from smart meters on RF / PLC communication and with HES on WAN.

3.4.3.1.1 Hardware & Power Supply of DCU

- Enclosure/box of DCU shall be minimum IP55 or better compliant. A suitable mounting arrangement required for DCU installation shall also be provided.
- A suitable and optimum power supply shall be provided keeping in view that even in case of outage in one or two phases, DCU can be powered. DCU should be capable of withstanding surges & voltage spikes of 6KV as per IEC 61000-4-5 standards. Power supply shall be terminated on suitable sized MCB to facilitate isolation during on-site maintenance.
- DCU shall have battery with backup for 5 hour for normal meter reading, to push tamper event, carry out on demand reading and the network health status/ connectivity continuity & check. DCU should have the suitable feature to send power outage and restoration message to the HES. The battery shall have a guaranteed life of 5 years.
- DCU shall have built in Real Time Clock (RTC) with separate battery backup. The battery shall have a guaranteed life of 5 years. It shall have self- diagnostic feature for RTC, memory, battery, communication module, etc. Alternatively, Software driven RTC may also be used as per agreement between supplier and utility.

3.4.3.1.2 Configuration, Functionality & Interface of DCU

DCU shall have following configuration functionalities:

- It shall be able to configure the communication with underlying nodes/meters.
- It shall pull data from the field devices and push the data at configured intervals to the HES. It should also support the HES in pulling data from the field devises/meters. The data acquisition (Push/Pull) frequency shall be programmable. DCU shall be capable to prioritize control commands.
- DCU shall ensure a secure communication to HES and shall have internal memory for storing interval data for at least 5 days.
- DCU shall support on demand read and ping of individual/group of meters.
- It shall support IPv4 and IPv6 network addressing.

- DCU shall push events like tamper, power off etc. to HES immediately on occurrence/receipt from field devices/meters.
- The equipment shall be weatherproof, dustproof and constructed for outdoor installation on poles (minimum rating: IP-55). A suitable mounting provision shall be made for the equipment.
- Enclosure: Provision for security sealing shall be provided and in case the gasket of the cover is used for protection against moisture, dust and insects, the gasket shall be made of weather and aging resistant material.
- The list of standards followed in all the devices/equipment used in communication network shall be furnished

3.4.3.1.3 DCU Communication

- The communication architecture shall be any, as defined under IS 16444.
- The DCU shall ensure the appropriate backhaul for secure transfer of data to HES either via GPRS 3G/4G or Fiber Optic communication. In case of GPRS/3G/4G backhaul, it shall support SIM card with dynamic IP from any service provider. It shall have Wide Area Network (WAN) connectivity to the HES through suitable means.
- DCU shall be able to communicate with meters either on RF mesh (Unlicensed or Licensed frequency band as permitted by WPC) or PLC.
- DCU shall periodically monitor meter reads/downstream commands and shall retry and reconnect in case of failed events/reads.
- It shall push events like tamper, power off etc. to HES immediately on occurrence/receipt from field devices/meters. DCU shall be able to acquire and send data to HES for full capacity (as per designed for no. of meters/field devices) to ensure the performance level. Full capacity of DCU is required to be indicated in the offer.
- After Power Interruption, on restoration of power supply, DCU shall establish communication with underlying devices as well as upstream application automatically.
- DCU shall be able to communicate with the nearest meters depending on topographical features. For further communication among the meters, distance of the other meters with the DCU shall not be a constraint as communication of the nearest meters shall be established with other meters through appropriate mesh formation / other formation.
- Remote Firmware Upgrade: The DCU shall support remote firmware upgrades as well as remote configuration from the control center. Configuration of programmable parameters of smart meters shall be done through HES.
- All meters falling under one DCU shall be commissioned and checked for proper communication in presence of utility in-charge.
- DCU shall keep the records of minimum of the following events:
  - No of packet failures
  - Retry attempts
  - Missed periodic readings
  - Failure to connect
  - Tamper events

3.4.3.2 Router based RF Mesh Network

In this type of communication network, different nodes (smart meters) shall interconnect with each other using RF mesh network and they shall communicate with nearby routers to transfer data to

access points/ HES. In such communication network, if any routers/repeaters/access points fail, then nodes connected on that device shall automatically reconfigure mesh with available nearby nodes.

3.4.3.2.1 General Requirement of Router based RF Mesh Network:

3.4.3.2.1.1 The general requirements for the Router based RF network are specified below:

a. The communication network shall have dynamic & self-healing capability. If one of the communication element like router or access point fails then nodes connecting to that element shall switch to best available element for communication of data to HES.

b. It shall support IPv4 and IPv6 network addressing.

c. Each node shall keep a track of best available nearby nodes.

d. The communication network equipment shall use Unlicensed or Licensed frequency band as permitted by WPC.

e. All the communication network equipment shall be certified by WPC, Government of India for operation in license free frequency band.

f. Suitable Network Management System (NMS) shall be available to monitor the performance of the communication network round the clock. The NMS shall provide viewing of all the networking elements deployed at site and enable configuration, parameterization of the networking devices and the nodes.

g. It shall support remote firmware upgrading

h. It shall be secure enough to avoid all cyber threats like DDoS, spoofing, malwares etc.

i. The communication network shall ensure secure communication of data to HES.

j. The equipment shall be weatherproof, dustproof and constructed for outdoor installation on poles (minimum rating: IP-55). A suitable mounting provision shall be made for the equipment.

k. Enclosure: Provision for security sealing shall be provided and in case the gasket of the cover is used for protection against moisture, dust and insects, the gasket shall be made of weather and aging resistant material.

l. The list of standards followed in all the devices/equipment used in communication network shall be furnished.

m. Routers / Access Points shall have suitable power supply arrangements. Provision of battery backup for at least 5 hour shall be there to continue operation in case of power supply failure. The life expectancy of battery shall be 5 years or more.

3.4.3.2.2 Configuration, Functionality & Interface

3.4.3.2.2.1 Access points shall have following configuration functionalities:

a. It shall be able to configure the communication with underlying nodes/end points.

b. It shall support on demand read and ping of individual/group of meters.

c. It shall push events like tamper, power off etc. to HES immediately on occurrence/receipt from field devices/meters.

d. It shall have Wide Area Network (WAN) connectivity to HES through suitable means.

e. It shall communicate with routers/nodes/end points on RF mesh (Unlicensed or Licensed frequency band as permitted by WPC).

f. It shall periodically monitor meter reads/downstream commands and shall retry and reconnect in case of failed events/reads.

g. After power Interruption, on restoration of power supply, it shall establish communication with underlying devices as well as upstream application (HES) automatically.

h. Access point shall facilitate recording of:
   i. No of packet failures
   ii. Retry attempts
   iii. Missed periodic reading
   iv. Failure to connect
   v. Tamper events

i. It shall be capable to handle interval data of suitable nos. of any type of smart meter (1ph/3ph). Access point shall be able to acquire and send data to HES for full capacity (No. of meters/field devices it is designed for) within a suitable time period to achieve the performance level. Full capacity of access point is required to be indicated in the offer.

j. Access point shall support remote firmware upgrades as well as remote configuration from the control center.

3.4.3.2.3 Testing of the DCU /Access Point

3.4.3.2.3.1 DCU/Access Point shall be tested for the following:
   a. Radio interference measurement (CIS PR 22)
   b. Surge test (IEC 610004-5)
   c. Fast transient burst test (IEC 61000-4-4)
   d. Test of immunity to electrostatic discharges (IEC 61000-4-2)
   e. Test of immunity to electromagnetic HF field (IEC 61000-4-3)
   f. Resistance to heat and fire

The bidder shall provide IP-55 compliance test certificate for DUC/Access Point.

3.5 Head End System (HES)

a. The main objective of HES is to acquire meter data automatically avoiding any human intervention and monitor parameters acquired from meters.

b. HES will be suitable to support collection and storage of data as per performance level for a defined no. of smart meters with facility of future expansion as per requirement of discom.

c. HES would perform all the requisite functions as per the defined functionalities of AMI and it is the responsibility of the bidder to supply the requisite software and hardware to achieve the defined functionalities of AMI. HES shall ensure data integrity checks, for example, checksum, time check, pulse, overflow, etc. on all metered data

d. HES shall be developed on open platform based on distributed architecture for scalability without degradation of the performance using additional hardware. HES shall support

storage of raw meter data, alarms and alerts for minimum 3 days. Adequate data base and security features for storage of data at HES need to be ensured.

e. The key functions of HES (not limited to) may be as follows:
   i. Acquisition of meter data on demand & at user selectable periodicity
   ii. Two way communication with meter/ DCU
   iii. HES shall ensure data integrity checks, for example, checksum, time check, pulse, overflow, etc. on all metered data
   iv. Signals for connect & disconnect of switches present in end points like meter
   v. Audit trail and Event & Alarm Logging
   vi. Encryption of data for secure communication
   vii. Maintain time sync with DCU / meter
   viii. Store raw data for defined duration (minimum 3 days)
   ix. Handling of Control signals / event messages on priority
   x. Setting of Smart meter configurable parameters
   xi. Communication device status and history
   xii. Network information in case more than one technology is deployed in field between the two devices
   xiii. HES shall export all meter data (as per IS 15959) to MDM via CIM/XML. In addition, it should conform to IEC 61968-9 as well as MultiSpeak v3.0 standards to interface with pre-existing MDM solution. In case, Discom has implemented any SOA/ ESB architecture, the data exchange to and from HES shall be through this ESB.
   xiv. Critical reporting functionality for the following suggestive critical events:
     ▪ Alarms and event log for meter events like tamper/power failures etc.
     ▪ Data not received from DCU/Meter
     ▪ Relay not operating for connect / disconnect
     ▪ Communication link failure with DCU/Meter
     ▪ Network failure, etc.
   xv. Non-Critical reporting functionality for the following suggestive non-critical events:
     ▪ Retry attempts on communication failure
     ▪ Periodic reading missing
     ▪ Failure to connect etc.

3.5.1 Configuration

3.5.1.1 HES shall facilitate programming of following meter parameters:

a. Load profile capture period
b. Demand integration period
c. Setting of parameters for time of day (TOD/TOU) billing
d. Prepaid function
e. Net metering
f. Billing date
g. Clock setting/time synchronizations
h. Load curtailment limit
i. Event setting for connect/disconnect
j. Number of auto reconnection attempt
k. Time interval between auto reconnection attempt

l. Lock out period for relay

m. Remote firmware upgrade

n. Password setting

o. Push schedule

p. Setting threshold limits for monitored parameters

q. Provision for adding more programming features in future (The bidder may suggest more parameters as per the requirement)

3.5.2 Communication

a. HES shall communicate with DCUs/access points using WAN technology

b. HES shall be able to accept data according to IS 15959 part-I/part-II

c. HES shall automatically retry for missed data; the number of retry attempts shall be configurable

d. To receive confirmation on successful execution of a command

e. HES shall ensure data integrity checks, for example, checksum, time check, pulse, overflow, etc. on all metered data

3.5.3 Monitoring and Reporting Capability

HES shall have critical and non-critical reporting functionality. The critical & non critical information generated from this reporting functionality shall be made available to MDM at user configurable periodicity.

3.5.3.1 **Critical Reporting**

a. HES shall have alarms & event log for node's (meter) events (tamper/power failures etc.)

b. If data not received from nodes/end points

c. If relay does not operate for connect / disconnect

d. Communication link failure with nodes/end points

e. Network Failure

3.5.3.2 **Non Critical Reporting**

3.5.3.2.1 HES shall report and keep record of following communication failure events:

a. Retry attempts

b. Missed periodic reading

c. Failure to connect

3.5.3.2.2 HES shall support reporting of communication failure history of nodes/routers/access points etc. and give an exception report for nodes/routers/access points not communicating for last 0 – 24 hours (the reporting period shall be on user configurable period). HES shall have feature to send email/SMS notification of configured alarms & events to selected users.

3.5.4 Integration

3.5.4.1 HES shall export all meter data (as per IS 15959) to MDM via CIM/XML. In addition, it should conform to IEC 61968-9 as well as MultiSpeak v3.0 standards to interface with pre-existing MDM solution. In case, utility has implemented any SOA/ ESB architecture, the data exchange to and from HES shall be through this ESB.

3.6 Meter Data Management System (MDMS)

The Meter Data Management System shall support storage, archiving, retrieval & analysis of meter data and various other MIS along with validation & verification algorithms. It shall act as a central data repository with interactive dashboard. MDMS 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.

MDMS also supports future requirement of Discom & supports 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 Monitoring system, self-healing system etc. as & when implemented by Discom.

MDM shall have the following core functionalities:

3.6.1 Asset Management

a. MDM shall maintain information and relationships between the current installed meter location (apartment, 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.
b. MDM shall also support device lifecycle management from device registration, installation, provisioning, operations and maintenance to decommissioning etc. The MDM shall generate exceptions for meter or modules not delivering the correct meter data after installation. The MDM shall provide a reconciliation report that identifies the meters that have been installed but not communicating for a designated (configurable) period. MDM shall generate reports on the number of meters installed in comparison to the number of meters successfully communicating.
c. The software should 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 is maintained throughout the device life with start and end dates associated with each in-service location reference.
d. Ability to report & log any damage/ deterioration in meter attributable to consumer /utility.

3.6.2 AMI Installation Support

a. The MDM shall also support device lifecycle management from device registration, installation, provisioning, operations and maintenance to decommissioning etc. The MDM shall generate exceptions for meter or modules not delivering the correct meter data after installation.
b. The MDM shall provide a reconciliation report that identifies the meters that have been installed but not communicating for a designated (configurable) period. MDM shall

generate reports on the number of meters installed in comparison to the number of meters successfully communicating.

3.6.3   Meter Data

a. The MDM 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 should be there to insert associated notes like assessed energy, etc.

b. The MDM should accept input, process, store, and analyze non-billing meter data such voltage and power quality data (like under/over voltage, out of band frequency, etc.) as they are available from AMI Head End Systems. The MDM shall also support schedule and on-demand meter reads and pinging of meter energized states by authorized users and by other Discom systems.

c. The MDM shall provide storage of all collected Meter Data, events and alarm. It shall have capacity of storing 5 years data or more via archiving.

d. The archiving of data should be done monthly and all data older than 30 days/hours should be archived. Bidder's solution should describe the process of archiving and restoration from the archive.

e. Correctly track & resolve energy usage across meter changes with no loss of individual meter data.

f. 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).

g. Execute on-demand read processes.

h. Handle special metering configurations like net metering/pre-paid metering/multiple meters at same premises.

i. The MDM shall have the ability to manage at a minimum 15 minute interval data.

j. The contractor shall ensure data integrity checks on all metered data received from data collection systems.

3.6.4   Data Validation, Estimation and Editing (VEE)

3.6.4.1   Validation and estimation of metered data shall be based on standard estimation methods (Like max/avg. of past three days, max/avg. of past 4 number of similar week days, max/avg. of similar blocks of past 4 numbers of similar week days etc.).

3.6.4.2   The MDM should also support and maintain following data:
a. Registered Read Data including register reads, daily billing cycle, as well as derived billing determinants like TOU

b. Interval Data channels with variable intervals and variable units of measure

c. Calculated Data that is derived or computed such as billing determinants and aggregated loads.

d. Event data storage of all collected event and alarm data from meters, network equipment, and MDMS itself

3.6.4.3   MDM shall flag, alarm and trigger an estimating process including but not limited to when the following anomalies occur in the cumulative ("CUM") register reads
a. CUM Decrements within a billing cycle (except net-metering)

b. CUM reads increments more than configurable threshold

c. Future or old read dates

d. Number of digits exceeds number of meter dials

3.6.4.4 MDM 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
   a. Register Decrements (except net-metering)
   b. Resets (to zero) (except net-metering)
   c. CUM reads increments more than configurable threshold
   d. Future or old read dates
   e. Erratic compared to CUM read (sum of TOU reads minus CUM read)

3.6.4.5 MDM shall detect, flag, alarm and trigger an estimating process including but not limited to when the following anomalies occur in Demand register reads
   a. Do not reset on cycle
   b. Do not reset coincident with customer move-out or move-in
   c. Reset off cycle inappropriately
   d. Too high

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

3.6.4.7 MDM shall estimate usage for non-metered service points such as street lights, farm lights, traffic signals, etc.

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

3.6.4.9 Notwithstanding the latency of data collection via the AMI system, once the MDM 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.

3.6.4.10 The MDM 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.

3.6.5 Billing Determinants Calculations

3.6.5.1 The MDM 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.

3.6.5.2 MDM would support the processing of interval data into billing determinants to include the Total Consumption Consumption in different time blocks for ToU billing, Maximum Demand (in kW and kVA), Number of tamper counts and Average power factor

3.6.5.3 MDM shall support the processing of interval data into billing determinants to include the following at a <u>minimum</u>:
   a) Total Consumption
   b) Consumption in different time blocks for ToU billing
   c) Maximum Demand (in kW and kVA)
   d) Number of tamper counts
   e) Average power factor

3.6.5.4   MDM shall process interval data and frame it into appropriate TOU periods for consumption & demand; for example, roll up 15/30 minute data intervals into hourly data.

3.6.5.5   MDM 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.

3.6.5.5.1 MDM 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 billing software

3.6.6   Exception Management

3.6.6.1   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.

3.6.6.2   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.

3.6.6.3   Exception Generation - MDM shall generate exceptions based on configurable business rules including but not limited to the following:
a. Meter tamper alerts
b. Communication module health alerts for Meter/DCU
c. If the consumption is less/more than pre-defined average consumption
d. Negative Consumption (not for net-metering)
e. Power outage indications received from the Smart meter

3.6.7   Service Orders

3.6.7.1   The MDM shall generate service orders based on configurable rules for various events and alarms such as stop meter, tampers, problem in communication networks, etc.

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

3.6.7.3   Service order tickets could be generated by MDM but processed and closed under jurisdiction of the HES-NMS combine. If the utility already has a separate Workforce Management System (WFM), then the service order tickets can be routed from the MDM and the NMS to the WFM for completion of the tasks and reporting.

3.6.8   Customer Service Support

3.6.8.1   The solution shall provide customers 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 Customer may also access data through customer portal. The solution shall integrate via a user friendly graphical interface.

3.6.8.2 MDM shall support email/SMS notification of configured alarms & events to selected users

3.6.8.3 MDM shall support the web portal or shall have the ability to interface with the 3rd party portal/utility 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 should support the view for past electricity usage, last week's, yesterday's, 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

3.6.8.4 MDM 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

3.6.9 Revenue Protection Support

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

3.6.9.2 Business rules for revenue protection alerts shall be configurable via a user-friendly interface.

3.6.9.3 MDM shall filter out revenue protection alerts that may be caused by field activities if the field activity information is provided to the MDM.

3.6.9.4 MDM shall support the analytics/investigation (i.e. view current and historical usage patterns) to validate suspected revenue protection issues

3.6.10 Analytics

3.6.10.1 The MDM 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 (hospitals, schools, govt. offices, multiplexes, commercial, residential, industrial etc.), or any user specified collection of meters.

b. Generate peak & off-peak load patterns by aggregating all loads of consumer group/consumer type/DT/Feeder over configurable period/day type.

c. 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 has to factor in data of energy export from net-metered consumers

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 sharing data with load 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. Analyzing 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. Five reliability indices shall be calculated:
   i. System Average Interruption Duration Index (SAIDI), which is sum of all customer interruption durations in a given period over total number of customers served
   ii. System Average Interruption Frequency Index (SAIFI), which is the total number of sustained interruptions in a given period over total number of consumers served.
   iii. 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
   iv. 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
   v. 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

i. 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

j. 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

k. Identify & visualize poor performing assets like feeder/DT on multiple criteria like energy losses, outage duration etc. through appropriate colour coding depending on severity thresholds

l. Analyze data of net-metering consumers to identify patterns of energy export to grid on hourly/weekly/monthly/yearly basis

3.6.11 Reporting

3.6.11.1 The Report function shall enable Utility to deliver reports in standard digital format such as PDF, Excel, etc. All queries for report generation shall be made through user driven drop down menu in GUI. Bidder shall provide example queries to support internal report generation needs. The GUI shall have provisions 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.

3.6.11.2 The solution shall support users modifying standard reports to better meet specific reporting requirements. The list of the standard reports that shall be provided with the MDM include 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 performance measurements
j. Threshold Exception
k. Ability to provide daily & weekly interface exception reports between MDM and other subsystems e.g. billing, outage, etc.

3.6.11.3 Following high level reports for Utility Management shall be generated at specified frequencies to help management with business decisions. For purpose of generating these reports, the system shall be capable of receiving data from external system through standard interfaces via CIM / XML.

Below is an example of reports that may be generated. These reports should be defined and agreed between employer and utility

Category	Report	Frequency
Energy Audit	Energy Audit Report: • A daily automatic feeder loss report (Feeder Head reading minus summation of all DT meters readings) • 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 • Identify the best as well as worst performing feeders and DTs	Daily, Monthly and User Selectable Time Period with configurable near real time alerts for 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	Daily, Monthly and User Selectable Time Period with configurable near real time alerts

Category	Report	Frequency
	consumers	
	Load Management Report (Identify top overloaded DTs)	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 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
Commercial Loss Detection	Tamper Alert: as per IS 15959 Part 2	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 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

Further, the report function shall generate reports on the following project KPIs for a user configurable time period. This will enable tracking the progress of project benefit parameters. Below is a list of suggestive KPIs to be monitored. These KPIs need to be defined and agreed between employer and utility

KPI Parameter	Baseline Scenario Value	Expected Value Post AMI Implementation
Billing Efficiency	<X>	<X>
Collection Efficiency	<X>	<X>
Peak Load	<X>	<X>
SAIFI	<X>	<X>
SAIDI	<X>	<X>
CAIFI	<X>	<X>
CAIDI	<X>	<X>
Transformer Failure Rate	<X>	<X>

3.6.12 Other Smart Grid Functionality Support

3.6.12.1 MDM should also support the interfacing of other smart grid functionalities like Demand Response, Outage Management System, Distribution Transformer Monitoring system, Electric vehicle charging Infrastructure, Roof Top PV Integration etc. as and when implemented by the utility.

3.6.13 Additional Features

3.6.13.1 Net-Metering

3.6.13.1.1 MDM shall flag, alarm and trigger an estimating process including but not limited to when the following anomalies occur:
   a. CUM decrements of forward energy within a billing cycle
   b. Register decrements for Time of Use (ToU) of forward energy
   c. Power generated(exported) by any net-metering consumer more than the installed capacity of solar PV rooftop system
   d. Energy exported(exported) in any given day by any net-metering consumer more than the programmable threshold value

3.6.13.2 Prepaid functionality

3.6.13.2.1 The prepaid functionality can either be availed at smart meter level or through MDM. In case of MDM, following shall apply
   a. The MDM should support pre-payment metering and capability to interface with pre-payment application.
   b. The prepayment should support the system that payment and connection parameters are stored centrally and the details are being updated to consumer portal/ app.
   c. The system should periodically monitor the energy consumption of prepaid consumer and decrease the available credit based on consumption.
   d. The system should send connect/disconnect command on the basis of available credit as per notified rules & regulations.
   e. The system should send low-credit notifications to the consumer when their balance approaches a threshold.

3.6.13.3 Utility User Interface

3.6.13.3.1 User interface for utility shall have ability for at least the following functionality:
   a. Compare total energy costs on one rate schedule vs. one or many alternative rates.
   b. Enable the user to see how different options within a rate affect costs.
   c. 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.
   d. Allow authorized users to view metered data, initiate and view reports, modify configurations, and initiate and update service requests via a GUI.
   e. 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.

f. Display via a GUI the energy usage profile for a single meter or group of meters according to Time of Use (ToU) tariff.

g. The GUI shall support a configurable utility dashboard for Operations and Utility Management

h. Access to a minimum of 5 years of historical energy usage and meter reads through the GUI.

i. GUI to clearly and visually distinguish between metered, estimated, allocated and substituted data.

j. GUI to provide role-based access based on user identity and user role. Shall have following types of users:
    i. Administrator
    ii. Operator
    iii. Field staff
    iv. Viewer/Guest

k. 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.).

l. 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.

m. User interface for utility to update the credit amount 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.

3.6.14 Integration with other Systems

3.6.14.1 MDM shall interface with other utility systems on standard interfaces, and the data exchange models and interfaces shall comply with CIM / XML / IEC 61968/ MultiSpeak / IS15959. MDM solution shall be Service Oriented Architecture (SOA) enabled.

3.6.14.2 The aim of the above interface standards is to ensure generic two way interfacing of the MDM with 3rd party applications. Towards this PFCCL/ HPSEB shall make arrangements to provide documented information on interface detail and specificity in implementation, of its existing systems, which need to interface with the MDM.

3.6.14.3 MDM integration with other systems shall include but not be limited to the following:
    a. Utility Administration
    b. HES for data exchange with AMI solutions
    c. Billing and collection system like Base Computing System (BCS)
    d. Existing other Data Collection Systems
    e. Support of interface with HHU or manual reading system etc.
    f. Consumer Portal

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

3.6.14.5 Contractor should provide suitable number of HHUs to read and update the data in MDM to meet contingency requirement in case of communication failure between meter and HES/MDM.

3.7 Customer Portal

3.7.1 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:

    a. 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.

    b. The portal/MDM shall support communication preferences for notification via email/SMS of configured alarms & events to selected users.

    c. The web portal or 3rd 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.

    d. 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. App shall also provide platform for implementation of peak load management functionality by providing existing tariff & incentives rates, participation options etc.

    e. Provide cross-browser compliant software (compatible with Internet Explorer, Chrome, Firefox, and Safari)

    f. The portal shall be linked to the on-line payment facility and gateway of the utility.

    g. Pre-paid consumers shall be provided facility to recharge their account

    h. Shall support the utility and in turn its customers with a system for logging, managing, and communicating technical issues.

3.7.2 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:

    a. The UI of the Portal shall allow selection of preferred language for dialogue like English, Hindi or any Local language

    b. View metered data, initiate and view reports

    c. View data according to Time of Use(ToU) tariff

    d. Can make request for connection/disconnection

    e. User can update mobile number/email

    f. Can initiate service requests for maximum demand updating, meter checking etc.

    g. In case on net-metering consumers, user can view data for both import & export

    h. In case of prepaid consumers, consumers can view recharge history & present balance.

    i. User interface shall require consumer id., mobile number & password for secure login.

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

3.8 Cloud Service Provider (CSP) Requirements

3.8.1 Operational Management

a. CSP should provide access of cloud virtual machines either by SSH in case of Linux and RDP in case of Windows servers.

b. CSP should enable HPSEB to get console access of cloud virtual machine from portal and perform operations.

c. HPSEB CSP should upgrade its hardware time to time to recent configuration to delivery expected performance for this Project.

d. Investigate outages, perform appropriate corrective action to restore the hardware, operating system, and related tools.

e. CSP should manage their cloud infrastructure as per standard ITIL framework in order to delivery right services to Project.
f. CSP should allow different users with different level of access on CSP portal. For example, billing user should not be able to provision resources or delete any resources

g. CSP should allow quota management for each department/ISV/Group. The resources to specific department/group/ISV should be as per allocated quota only. If there is any request for more than quota request, then it should be sent as request to admin.

3.8.2 Compatibility Requirements

a. CSP must ensure that the virtual machine format is compatible with other cloud provider.

b. CSP should give provision to import cloud VM template from other cloud providers.

c. CSP should ensure connectivity to and from cloud resources used for this project is allowed to/ from other cloud service providers if require.

3.8.3 Cloud Network Requirement

a. CSP must ensure that cloud virtual machine of project is into separate network tenant and virtual LAN.

b. CSP must ensure that cloud virtual machines are having private IP network assigned to cloud VM.

c. CSP must ensure that all the cloud VMs are in same network segment (VLAN) even if they are spread across multi datacenters of CSP.

d. CSP should ensure that cloud VMs are having Internet and Service Network (internal) vNIC cards.

e. CSP should ensure that Internet vNIC card is having minimum 1 Gbps network connectivity and service NIC card is on 10 Gbps for better internal communication.

f. In case of scalability like horizontal scalability, the CSP should ensure that additional require network is provisioned automatically of same network segment.

g. Must ensure that public IP address of cloud VMs remains same even if cloud VM gets migrated to another data center due to any incident.

h. CSP must ensure that public IP address of cloud VMs remains same even if cloud VM network is being served from multiple CSP datacenters.

i. CSP must ensure that the public network provisioned for cloud VMs is redundant at every point.

j. CSP must ensure that cloud VMs are accessible from HPSEB private network if private links P2P/MPLS is used by HPSEB.

k. CSP must ensure that there is access to cloud VMs if HPSEB require to access it using IPSEC/SSL or any other type of VPN.

l. CSP should ensure that cloud VM network is IPV6 compatible.

m. CSP should have provision of dedicated virtual links for data replication between their multiple datacenter in order to provide secure data replication for DR services.

n. CSP should ensure use of appropriate load balancers for network request distribution across multiple cloud VMs.

3.8.4 Cloud Data Center specifications

a. The datacenter of CSP must be within India only.

b. All the physical servers, storage and other IT hardware from where cloud resources are provisioned for this project must be within Indian datacenters only.

c. The datacenters of CSP should be spread across different geolocation in different seismic zones.

d. The CSP datacenters should have adequate physical security in place.

e. The CSP datacenters should comply/certified Tier III datacenter norms.

f. The Data Center should conform to at least Tier III standard (preferably certified under TIA 942 or Uptime Institute certifications by a 3rd party) and implement tool-based processes based on ITIL standards.

3.8.5 Cloud Storage Service Requirements

a. CSP should provide scalable, dynamic and redundant storage.

b. CSP should offer provision from self-provisioning portal to add more storage as and when require by HPSEB.

c. CSP should clearly differentiate its storage offering based on IOPS. There should be standards IOPS offering per GB and high-performance disk offering for OLTP kind of workload. CSP should delivery minimum 8000 IOPS per TB for OLTP load. The IOPS for

d. NON OLTP load should be minimum 3000 per TB.

e. CSP should have block disk offering as well as file/object disk offering to address different kind of Project needs.

3.8.6 Cloud Security Requirements

a. CSP should ensure there is multi-tenant environment and cloud virtual resources of this project are logically separated from others.

b. CSP should ensure that any OS provisioned as part of cloud virtual machine should be patched with latest security patch.

c. In case, CSP provides some of System Software as a Service for project, CSP is responsible for securing, monitoring, and maintaining the System and any supporting software.

d. CSP should implement industry standard storage strategies and controls for securing data in the Storage Area Network so that clients are restricted to their allocated storage

e. CSP should deploy public facing services in a zone (DMZ) different from application services. The Database nodes (RDBMS) should be in a separate zone with higher security layer.

f. CSP should give ability to create non-production environments and segregate (in a different VLAN) non-production environments from the production environment such that the users of the environments are in separate networks.

g. CSP should have built-in user-level controls and administrator logs for transparency and audit control.

h. CSP cloud platform should be protected by fully-managed Intrusion detection system using signature, protocol, and anomaly based inspection thus providing network intrusion detection monitoring.

3.8.7 Data Management

a. CSP should clearly define policies to handle data in transit and at rest.

b. CSP should not delete any data at the end of agreement without consent from HPSEB.

c. In case of scalability like horizontal scalability, the CSP should ensure that additional generated data is modify/deleted with proper consent from HPSEB.

3.8.8 Disaster Recovery Management

a. CSP is responsible for Disaster Recovery Services so as to ensure continuity of operations in the event of failure of primary data center and meet the RPO and RTO requirements.

b. RPO should be less than or equal to 2 hours and RTO shall be less than or equal to 12 hours

c. There shall be asynchronous replication of data between Primary DC and DRDC and the CSP will be responsible for sizing and providing the DC-DR replication link so as to meet the RTO and the RPO requirements.

d. During normal operations, the Primary Data Center will serve the requests. The Disaster Recovery Site will not be performing any work but will remain on standby. During this period, the compute environment for the application in DR shall be available but with minimum possible compute resources required for a functional DR as per the solution offered. The application environment shall be installed and ready for use. DR Database Storage shall be replicated on an ongoing basis and shall be available in full (100% of the PDC) as per designed RTO/RPO and replication strategy. The storage should be 100% of the capacity of the Primary Data Center site.

e. In the event of a site failover or switchover, DR site will take over the active role, and all requests should be routed through that site. The pre-requisite to route request to DR should be articulated properly and shared by CSP.

f. Whenever there is failover from primary to secondary, compute environment for the application at DR site shall be equivalent to DC

g. The installed application instance and the database shall be usable and the same SLAs as DC shall be provided.

h. The bandwidth at the DR shall be scaled to the level of Data center when DR is activated.

i. The CSP shall clearly define the procedure for announcing DR based on the proposed DR solution. The CSP shall also clearly specify the situations in which disaster shall be announced along with the implications of disaster and the time frame required for migrating to DR. The CSP shall plan all the activities to be carried out during the Disaster Drill and issue a notice to the Department at least two weeks before such drill.

j. The CSP should offer dashboard to monitor RPO and RTO of each application and database.

k. Any lag in data replication should be clearly visible in dashboard and alerts of same should be sent to respective authorities.

3.8.9   Managed Services

a. **Network and Security Management:**
   i. Monitoring & management of network link proposed as part of this solution.
   ii. Bandwidth utilization, latency, packet loss etc.
   iii. Call logging and co-ordination with vendors for restoration of links, if need arises.
   iv. Addressing the ongoing needs of security management including, but not limited to, monitoring of various devices / tools such as firewall, intrusion protection, content filtering and blocking, virus protection, and vulnerability protection through implementation of proper patches and rules.
   v. Ensuring that patches / workarounds for identified vulnerabilities are patched / blocked immediately
   vi. Ensure a well-designed access management process, ensuring security of physical and digital assets, data and network security, backup and recovery etc.
   vii. Adding/ Changing network address translation rules of existing security policies on the firewall
   viii. Diagnosis and resolving problems related to firewall, IDS /IPS.
   ix. Managing configuration and security of Demilitarized Zone (DMZ) Alert / advise HPSEB about any possible attack / hacking of services, unauthorized access / attempt by internal or external persons etc.

b. Server Administration and Management:

i. Administrative support for user registration, User ID creation, maintaining user profiles, granting user access, authorization, user password support, and administrative support for print, file, and directory services.
ii. Installation/ re-installation of the server operating systems and operating system utilities
iii. OS Administration including troubleshooting, hardening, patch/ upgrades deployment, BIOS & firmware upgrade as and when required/ necessary for Windows, Linux or any other O.S proposed as part of this solution whether mentioned in the RFP or any new deployment in future.
iv. Ensure proper configuration of server parameters, operating systems administration, hardening and tuning
v. Regular backup of servers as per the backup & restoration
vi. Managing uptime of servers as per SLAs.
vii. Preparation/ updation of the new and existing Standard Operating Procedure (SOP) documents on servers & applications deployment and hardening

3.8.10 Backup Services

a. CSP must provide backup of cloud resources. The backup tool should be accessible

b. To perform backup and restore management as per policy & procedures for backup and restore, including performance of daily, weekly, monthly, quarterly and annual backup functions (full volume and incremental) for data and software maintained on the servers and storage systems using Enterprise Backup Solution.

c. Backup and restoration of Operating System, application, databases and file system etc. in accordance with defined process / procedure / policy.

d. Monitoring and enhancement of the performance of scheduled backups, schedule regular testing of backups and ensure adherence to related retention policies

e. Ensuring prompt execution of on-demand backups & restoration of volumes, files and database applications whenever required.

f. Real-time monitoring, log maintenance and reporting of backup status on a regular basis.

g. Prompt problem resolution in case of failures in the backup processes.

h. Media management including, but not limited to, tagging, cross-referencing, storing (both on-site and off-site), logging, testing, and vaulting in fire proof cabinets if applicable.

i. Generating and sharing backup reports periodically

j. Coordinating to retrieve off-site media in the event of any disaster recovery

k. Periodic Restoration Testing of the Backup

l. Maintenance log of backup/ restoration

m. CSP should provide network information of cloud virtual resources.

n. CSP must offer provision to monitor network uptime of each cloud virtual machine.

3.8.11 Web Application Firewall as Service

a. Cloud platform should provide Web Application Filter for OWASP Top 10 protection

b. CSP WAF should be able to support multiple website security.

c. CSP WAF should be able to perform packet inspection on every request covering all 7 layers.

d. CSP WAF should be able to block invalidated requests.

e. CSP WAF should be able to block attacks before it is posted to website.

f. CSP WAF should have manual control over IP/Subnet. i.e., Allow or Deny IP/Subnet from accessing website.

g. The attackers should receive custom response once they are blocked.

h. CSP must offer provision to customize response of vulnerable requests.

i. CSP WAF should be able to monitor attack incidents & simultaneously control the attacker IP.

j. CSP WAF should be able to Greylist or Backlist IP/Subnet.

k. CSP WAF should be able to set a limit to maximum number of simultaneous requests to the web server & should drop requests if the number of requests exceed the threshold limit.

l. The WAF should be able to set a limit to maximum number of simultaneous connections per IP. And should BAN the IP if the threshold is violated.

m. Should be able to set a limit to maximum length of path to URL.

n. Should be able to limit maximum size of request to Kilobytes.

o. CSP WAF should be able to limit maximum time in seconds for a client to send its HTTP request.

p. Should be able to BAN an IP for a customizable specified amount of time if the HTTP request is too large.

q. Should be able to limit maximum size of PUT request entity in MB

r. The WAF should be able to close all the sessions of an IP if it is ban.

s. Should be able to Ban IP on every sort of attack detected and the time span for ban should be customizable. There should be a custom response for Ban IP.

t. The Dashboard should show a graphical representation of
   i. Top 5 Attacked Websites.
   ii. Top 5 Attacking IP.
   iii. Top 5 Attack types.
   iv. Top 5 Attacked URLs.

u. For analysis purpose the Dashboard should contain following information:
   i. Number of requests to web server.
   ii. Number of attacks.

     iii.   Number of Attackers.

     iv.   Types of error messages and on. Of error messages sent to the users.

     v.   Total Bytes sent during transaction

3.8.12 Database support service

a. Installation, configuration, maintenance of the database (Cluster & Standalone).

b. Regular health checkup of databases.

c. Regular monitoring of CPU & Memory utilization of database server, Alert log monitoring & configuration of the alerts for errors.

d. Space monitoring for database table space, Index fragmentation monitoring and rebuilding.

e. Performance tuning of Databases.

f. Partition creation & management of database objects, Archiving of database objects on need basis.

g. Patching, upgrade & backup activity and restoring database backup as per defined interval.

h. Schedule/review the various backup and alert jobs.

i. Configuration, installation & maintenance of Automatic Storage Management (ASM), capacity planning/sizing estimation of the Database setup have to be taken care by the vendor.

j. Setup, maintain and monitor the 'Database replication' / Physical standby and Asses IT infrastructure up-gradation on need basis pertaining to databases.

3.8.13 Cyber Security

a. Bidder shall submit detailed document on end-to-end implementation of security architecture detailing.

b. System shall comply to the best security standards and practices followed in Power Utilities.

c. The system should be having the features of token based authentication system, tracking and log maintenance of successful and failed login attempts, archiving of failed login attempts, user access control, encrypting passwords,

d. The system should have the implementation of Password revocation, tokens for authentication, encryption mechanisms, intrusion detection mechanism and prevention

e. The system should be able to detect service impact attack and mitigation plan

f. Certifications from standard laboratory for cyber security compliances should be submitted.

g. System should have encryption mechanisms for security patches & software delivered over internet.

h. The software delivered by the bidder should be free from backdoors, Trojans viruses and worms and other malicious vulnerabilities.

i. The supplier shall provide necessary firewalls, anti-virus software and other malicious software detection, prevention and removal tools.

4. Service Level Agreements

4.1 These performance levels shall apply to the complete AMI system.

4.2 AMI system includes the communications links provided by Network Provider /third parties such as telecommunications companies and bidder has to ensure the desired performance level.

4.3 The performance levels exclude force majeure events.

4.4 The Contractor shall ensure achieving the following Service Levels during the project operation & maintenance phase :

Data Type	Performance Requirement
1. Scheduled Interval data readings at a fixed periodicity during the day as decided by utility	
Periodic collection of the 15/30 minute interval load profile data after every 15/30/60/120 minutes	From 95% of meters within 5 minutes
	From 98% of meters before next periodic packet is scheduled.
2. Scheduled daily meter readings (as per IS 16444/15959)	
Daily collection of the previous day's interval energy data and total accumulated energy	From 95% of meters within 8 hours after midnight; and
	From 99.5% of meters within 24 hours after midnight
3. Scheduled billing/ load profile data for bill period	
Collection of billing/load profile data for the bill period for entire installed population	From 95% of meters within 24 hours after midnight; and
	From 99.5% of meters within 48 hours after midnight
4. On-Demand Remote reads of meters	
Collection of 7 days of interval energy data and the current total accumulated energy from a group of 1000 AMI meters	Action performed at 90% of meters within 1 Hour; and
	Action performed at 99% of meters within 2 hours; and
	Action performed at 99.5% of meters within 6 hours
Collection of 7 days of interval energy data & current total accumulated energy from a selected individual meter	Action performed within 30 seconds
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 consumers within 5 minutes after receiving the data in MDM
	Action performed at 99.5% of meters within 2 hours after receiving the data in MDM.
6. Ping Response with acknowledgement/ response for selected meters	
For a group of 1000 meters	Action performed at 99.5% of meters within 1 minute; and

Data Type	Performance Requirement
For an individual meter	Action performed within 3 seconds
7. Remote load control commands for selected meters with acknowledgement/ response for selected meters	
For a group of maximum of 5000 AMI meters	Action performed at 95% of meters within 5 minutes; and
	Action performed at 99% of meters within 10 Minutes
For an individual meter	Action performed within 5 seconds
8. For remote connect/disconnect with acknowledgement/ response for selected meters	
For a group of maximum of 5000 AMI meters	Action performed at 90% of meters within 5 minutes; and
	Action performed at 99% of meters within 10 minutes; and
	Action performed 99.5% of meters within 20 minutes
For an individual meter	Action performed within 30 seconds
9. 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
10. Meter Tamper Alerts	
Receiving of alert for an individual meter	Alert to be received within 3 minutes
11. Power Quality Alerts	
Receiving of alert for an individual meter	Alert to be received within 5 minutes
12. Remotely altering settings in meter/ firmware upgrade with acknowledgement/ response for selected meters	
For a group of 1000 AMI meters	Action performed at 99% of meters within 30 minutes; and
	Action performed at 99.5% of meters within 1 hour
13. Remotely read events logs	
For reading the full event log for a group of 1000 AMI meters	Action performed at 90% of meters within 30 minutes; and
	Action performed at 99% of meters within 1 hour; and
	Action performed at 99.5% of meters within 6 hours.
14. AMI Network (all hardware, software, smart meters, Cloud Infrastructure and field equipment) Uptime	99% on Monthly basis. Penalty will be 1% of the FMS Charges per month for every 1% or part there of decrease in availability under 99%). Penalty will be calculated separately for Hardware and Software Availability. The maximum deduction shall be limited to FMS charges paid for that particular period.
15. Cloud Infrastructure uptime	99%

Data Type	Performance Requirement
16. Recovery Point Objective for AMI MDM and HES System	4 Hours
17. Recovery Time Objective for AMI MDM and HES System	12 Hours

4.5 For the above performance requirement, PFCCL/ HPSEB will review the performance of Contractor against the SLA after every 30 days. Post evaluation, an audit report of the same will be submitted by the Contractor to PFCCL/ HPSEB.

4.6 Further, for meeting SLAs as defined above, MDMS should be able to generate standard reports for these parameters. During performance evaluation, the generated reports shall be randomly checked with data by PFCCL/ HPSEB.

4.7 The user interface performance testing shall be done as per following criteria:

S.No.	User Interface Requirements	Response Time
1	Any real time display and application display on workstation console along with data values shall appear on screen.	Within 2 sec
2	Manual data entry of the new value appears on screen.	Within 2 sec
3	Display Update rate	2 sec for 4 displays together
4	Response time for display of Alarm and event after receipt in system	Within 1 sec of receipt in system
5	Requests for printing of displays (to be acknowledged with an indication of request is being processed).	Within 2 sec
6	Requests for generation of reports (to be acknowledged with an indication of request is being processed).	Within 2 sec

4.7.1 The user interface performance testing shall be taken by PFCCL/ HPSEB after every 30 days in presence of the contractor. A audit report of the same will be submitted by the contractor to PFCCL/ HPSEB.

5. Training Requirements

5.1 General

5.1.1   General requirement for training to be imparted is as follows:

   a. Training shall be conducted by Contractor personnel who are experienced instructors and speak understandable English.
   b. The contractor shall provide training to various user groups nominated by PFCCL/ HPSEB. The bidder shall provide the Training Approach in the response
   c. All necessary training material shall be provided by the Contractor. 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 PFCCL/ HPSEB. PFCCL/ HPSEB reserves the right to copy such materials, but for in-house use only.
   e. 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.
   f. The training will consist of a curriculum of courses to address the issues of system operation, business-wide application, changed business processes and general use of the new system.
   g. Representatives from the contractor, PFCCL/ HPSEB 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.
   h. The contractor is required to quote on per day basis for Training
   i. PFCCL/ HPSEB will have option to cancel any or all training. In the case of cancellation, the rate quoted against the respective training will not be paid to the Contractor.

5.1.2   The training modules shall include but not limited to –
   a. AMI Administration & Configuration
   b. AMI Installation and Trouble-Shooting
   c. Application Management
   d. Application Data Analysis

5.1.3   The contractor shall be required to organize following training for the PFCCL/ HPSEB personnel: -

   a. **Professional Training** - This is the training for the core group of implementation team of the PFCCL and HPSEB. This team will comprise of members from all the Business Functions and IT sections. Each member would be trained in the relevant function/ module. It is the responsibility of contractor to deliver this training. Standard curriculum, designed and agreed by the PFCCL/ HPSEB for hardware, software and network preferably shall be arranged by the contractor for each group. PFCCL/ HPSEB will prefer if a portion of the training is conducted on-site.

b. **End User Training** - The contractor will provide training to the owner's team on a "Train the Trainer" basis. HPSEB team so trained will then train all of the HPSEB's end users. 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 class rooms, etc.

5.1.4 In addition two Engineer's from utility and/ or PFCCL shall be stationed at the contractor's works during development/customization of solution as per tender. The deputed utility/ PFCCL engineers shall be involved with the project till its completion.

6. System Hardware Requirements

This section describes the technical requirements of all the hardware envisaged in the BOQ for the control centre system. The minimum hardware specifications (Processor, RAM, Aux. Memory, interfaces etc.) for all equipment are specified in Technical Specification for hardware. The contractor has to submit the details of the supplied hardware along with the bid. The Contractor shall asses the adequacy of hardware specified in the BOQ & if any additional hardware or higher end hardware configurations are required to meet all the requirements of the Technical Specifications, the same shall be included in the offer. The Bidder's proposal shall include necessary calculations to clearly establish that the proposed hardware meets the functional and performance requirements of the Technical Specification.

The Bidders are encouraged to optimize the requirement of hardware for servers and processors where one or more applications can be combined or distributed in any combination with adequate redundancy without affecting the performance requirement. However critical applications shall have redundancies in hardware.

6.1   Technical Requirements for Hardware

All hardware shall be manufactured, fabricated, assembled and finished with workmanship of the highest production quality and shall conform to all applicable quality control standards of the original manufacturer and the Contractor. All hardware components shall be new and suitable for the purposes specified.

All hardware shall include self-diagnostic features. On restoration of power after interruption they shall resume operation automatically. All servers, workstations and network equipment (Switches, routers, firewall etc.) shall be compatible for remote monitoring using secure SNMP Ver. 3.0. All hardware shall support both IPv6 and IPv4 simultaneously.

The contractor shall ensure that at the time of final approval of hardware configuration and BOQ, all the hardware is as per the current industry standard models and that the equipment manufacturer has not established a date for termination of its production. Any hardware changes, except version upgrade in same series, proposed after contract agreement shall be subject to the following:-

   a) Such changes/updates shall be proposed and approval obtained from PFCCL/ HPSEB along with the approval of Drawings/documents.
   b) The proposed equipment shall be equivalent or with better features than the equipment included in the Contract.
   c) Complete justification along with a comparative statement showing the original and the proposed hardware features/parameters including brochures shall be submitted to PFCCL/ HPSEB for review and approval.
   d) Changes/updates proposed will be at no additional cost to the Employer.
   e) The porting of software shall be at no additional cost in case of replacement of hardware during the AMC period.

6.2 Hardware Configuration

In this Technical Specification all hardware has been broadly classified as "Server" and "Peripheral device". The term "server" (also referred as "processor") is defined as any general- purpose computing facility used for hosting application functions as defined in the specification. The servers typically serve as the source of data, displays and reports. The term "Peripheral Device" is used for all equipment other than servers. Peripheral device includes workstation consoles, WAN router, LAN, printer, firewalls etc.

Redundant hardware such as Servers, Firewall, and LAN etc. shall work in hot stand by manner. All servers and networking equipment (Firewalls, LAN equipment etc.) shall be mounted in rack panel.

The minimum technical specification to be followed for any hardware equipment required would be as per the requirement of HPSEB.

6.3 General Device Configuration of Network Equipment

The device configuration of all the network equipment shall be as per the latest Cyber Security guidelines given by CERT-In / NCIIPC/ Ministry of Power or any other competent authority.

6.3.1 Firewall

Firewalls should be properly configured to segregate networks into different segments. The following strategies shall be followed for secure configuration of firewalls.
   a) Cleanup rule.
   b) Place a "Deny Any-Any" rule at the end of the rule base.
   c) Never create an "Allow any-any" rule.
   d) Allow rules should be created only for required services.
   e) This will result in all traffic being disallowed, unless specifically allowed.
   f) Lockdown/stealth rule
   g) All traffic destined for the firewall itself should be disallowed.
   h) Place anti-spoofing rule as per RFC 2827.
   i) Enable DoS/DDoS features on Firewall
   j) Enable application level filtering of firewall

6.3.2 Router

Necessary control should be applied on the router to stop unwanted traffic and attacks at the perimeter itself. In the secure configuration of a router, the following strategies should be considered.
   a. Deploy proper access management and avoid remote administration.
   b. Enable password.
   c. Change default SNMP community string.
   d. ACLs (Access Control Lists) should include
      i. Apply egress/ingress filter
      ii. Filter all RFC 1918, 3330 address space and special/reserved address
      iii. Permit the required services for the required IP addresses only
      iv. Deny everything else.

e. Turn on logging to a central syslog server.

6.3.3   Intrusion Detection & Prevention System

The required features of the Host Based Intrusion Detection Systems (HIDS) and Network based Intrusion Prevention System (NIPS) are described below:

6.3.3.1   Intrusion Detection and Prevention System (Host Based)

Host based Intrusion Detection and Prevention System module shall be provided for all machines. IDS shall be able to perform following actions:

a. Capability for Detecting the intrusion attempt that may take place, intrusion in progress and the intrusion that has taken place.
b. Flag and check unauthorized access
c. Notify/Alarm/message of intrusion to:
    i. Management console
    ii. Event log
    iii. Administrator by e-mail
d. Create an audit trail for user and file access activity, including file accesses, changes to file permissions, attempts to install new executables and/or attempts to access privileged services
e. In an event where user accounts are added, deleted, or modified, changes to key system files and executables is done in by unauthorized account or there is unauthorized attempt to overwrite vital system files, to install Trojan horses or backdoors suitable action should be taken such as:
    i. Terminate User (intruder) Login
    ii. Disable User (intruder) Account
    iii. Forge a TCP FIN packet to force intruder connection to terminate
f. Should provide events check for suspicious file transfers, denied login attempts, physical messages (like an Ethernet interface set to promiscuous mode) and system reboots.

6.3.3.2   Network based Intrusion Prevention System (NIPS)

The NIPS shall provide complete inline protection from network-based application layer threats by scanning packet payloads for malicious traffic. It shall detect, classify and stop malicious application, viruses, worms and spyware/adware etc.

After detecting an intrusion attempt NIPS should be able to perform following actions:

a. Reconfigure the firewalls provided in this package
b. Send an SNMP Trap datagram to the management console.
c. Send an event to the event log.
d. Send e-mail to an administrator to notify of the attack.
e. Save the attack information (timestamp, intruder IP address, victim IP address and port, protocol information)
f. Force intruder connection to terminate.

7. System Software Requirements

This section describes the characteristics of system software such as operating system, database and support software (compilers, DBMS, display development, network utilities, report generation, diagnostics and backup utilities) provided by contractor and the original software manufacturer as necessary to support the functioning of AMI Applications systems. All the system software to be used for present scope of work shall have authentic license valid for life time. This section also describes the standards to be followed for all supplied software.

7.1 Software Standards

All software provided by the contractor under this AMI RFP, including the operating system, database and support software, shall comply with the industry-accepted software standards. In areas where these organizations have not yet set standards, the software shall comply with those widely accepted de-facto open standards put forth by industry consortiums, such as OSF and X/Open. The Contractor shall commit to meet the "open systems" objective promoted by industry standards groups.

7.1.1 Design and Coding Standards for AMI Applications and Utilities

These provisions are applicable for both software applications and operating systems and would address program features that must be contained in software for the product to meet the standards.

a. When software is designed to run on a system that has a keyboard, product functions shall be executable from a keyboard where the function itself or the result of performing a function can be distinguished textually.
b. A well-defined on-screen indication of the present focus shall be provided that moves among interactive interface elements as the input focus changes.
c. Applications shall not override user selected contrast and color selections and other individual display attributes.
d. When animation is displayed, the information shall be displayable in at least one non-animated presentation mode at the option of the user.
e. Software shall not use flashing or blinking text, objects, or other elements having a flash or blink frequency greater than 2 Hz and lower than 55 Hz.

7.1.2 Applications

All components of AMI application system shall be maintainable by owner using the supplied software utilities and documentation. The software design and coding standards of the system shall address the followings:

a. **Expansion**: Software shall be dimensioned to accommodate the size of AMI application system as given in BOQ and Appendix-G.(Separate sheet for Sizing)
b. **Modularity**: Software shall be modular i.e. functionally partitioned into discrete, scalable, reusable modules consisting of isolated self-contained functional elements & designed for ease of change. The system shall make maximum use of common industry standards for interfaces.

c. **User-Directed Termination**: Functions taking long execution times shall recognize and process user requests to abort the processing.

d. **Portability & Interoperabilit**y: The system shall be designed for hardware independence and operation in a network environment that facilitates interoperability and integration of third party applications. AMI applications should support multiple RDBMS systems including Oracle, Microsoft SQL Server and MySQL.

e. **Programming Languages**: The software shall be written using high level ISO or ANSI standard programming languages.

All applications shall be designed with sufficient background logs which capture various level of errors encountered (warning, fatal, informational) while executing, so that the same can be reviewed and attended to.

7.1.3 Operating System

The operating system of all the equipment of AMI application system including network equipment shall be latest version released up to six months prior to FAT. The operating system shall be hardened to provide robust security. The operating system and data file shall be placed in different disk partitions.

In order to facilitate cyber security requirements including patch management, common operating system is preferable to be used by all server nodes within AMI application including MDM/HES servers. This is also to minimize maintenance. All licenses for Operating System & other application software shall be supplied by the contractor and shall be valid throughout the operating life.

7.1.4 Time and Calendar Feature

The AMI application & other servers shall maintain time and calendar for use by various software applications. The internal clocks of all servers and workstation consoles shall be automatically synchronized on NTP protocol. The calendar shall be customizable for working hours, holidays, weekends etc. The holidays, including type of days, shall be entered for each year at the beginning of the year and shall be recognized by all applications.

The user shall be able to alter the date and time. The alteration shall not adversely affect programs running at the beginning of the hour.

7.1.5 Remote Diagnostic

Remote Diagnostic facility with necessary hardware as required shall be provided for communication between the AMI application system at control center and the Contractor's & HPSEB's support office for the diagnosis of hardware & software problems. The login shall be protected by a user name & password entry. An automatic intimation shall be provided to inform authorized person from utility on such events of remote access and diagnosis.

7.1.6 Development System as a Test Bench

A Development system independent of the production environment shall be defined which shall provide testing facility for integration of changes/modifications of the AMI application and new field

devices before putting it online with Real-time system. This Development system shall be on a LAN separated from the production LAN and shall be self-sufficient to carryout testing of changes/ modifications.

7.2   Network Software

The network software system shall include software for network communication, network security, security management, patch management and network services. Network software shall include the user node software that provides the connection of that node to the network. The network node software shall be provided for each type of network node connection supplied with the initial system and shall be licensed for the quantities and types of nodes defined in the system configuration. Network software shall have scalability feature as envisaged.

7.2.1   Network Communication

Users and various applications shall be able to communicate within the local area network and operate as described in this Specification. The network communications software shall use a standard network protocol such as TCP/IP, UDP etc. and shall support both IPv4 and IPv6. The software shall link dissimilar hardware nodes such as local and remote workstations, servers, and peripheral devices into a common data communication network allowing communications among these devices.

7.2.2   Network Services

The following network services shall be provided for the users within the LAN:
   a. Network file management and transfer of files containing text, data, and graphics information
   b. Network printing management
   c. Network time synchronization
   d. Backup over LAN (Storage Area Network)
   e. Task-to-task communications to external computers
   f. LAN global naming facilities
   g. Remote procedure call
   h. Remote terminal session

7.2.3   Network Management System (NMS)

The proposed network management system shall facilitate following activities:

   a. Security Management to protect systems and network from unauthorized access, manage user access, authorizing rights and privileges.
   b. Viewing of all network elements deployed and administer configuration changes of the network devices and nodes through toolkits to automate the following tasks :
      i. Capture running configuration, Capture startup configuration, Upload configuration
      ii. Compare configuration
      iii. Real-time or scheduled capture of device configurations
      iv. Store historical device configurations captured and   enable comparison of current device configuration against a previously captured configuration
   c. Security patch management shall be encrypted and signed.

d. Inventory Management to collect information about computers in the system such as processors, memory, peripherals and processes running on computers.
e. Performance Management to monitor system and network performance as specified.
f. Fault Management to recognize, isolate, log and identify fault on network and connected machines, nodes, devices.

The network management software shall be based on the latest secured version of Simple Network Management Protocol ver. 3.0 (SNMPv3). The NMS system shall have a simple browser based user interface to provide all the pertinent information about the system. The NMS shall not impact the availability and performance of AMI applications and shall load not more than 3% of any host CPU, 1% of network bandwidth and shall have secure communication.

The network management system shall monitor the performance, resource usages and error statistics of all the servers, workstations, routers and LAN devices including for proposed Utility networks extension (up to 25 number of nodes) including the following:-

a. Utilization (CPU and/or channel time being used as applicable) for
   i. Servers, Workstations, Storage Devices (SAN, HDD etc.)
   ii. LAN, Firewalls(internal & External), Router, Switches
   iii. Data Links

b. Memory utilization, auxiliary memory I/O utilization, of
   i. Servers and Other Machines
   ii. Mass Storage Devices

c. Bandwidth utilization for Routers/Switches
   i. Various interface statistics shall be connected from network devices to measure the performance level

The Network Management Software shall have following functionality:
a. It shall maintain performance, resource usage & error statistics and present this information via displays, periodic reports and on-demand reports.
b. Apart from real-time monitoring of critical network devices, the above information shall be collected and stored at user configurable periodicities i.e. 5 minutes to 60 minutes. The Network Management System (NMS) shall be capable of storing the above data for a period of one (1) year at an interval of 5 minutes.
c. It shall maintain a graphical display for connectivity and status of servers and peripheral devices in local area network. The monitored devices shall be configured to send SNMP notifications, and the graphical element representing the device shall change to a different colour depending on the severity of the notification received.
d. It shall issue alarms when error conditions or resource usage problems occur.
e. The period over which the statistics are gathered shall be adjustable by the user and the accumulated statistics shall be reset at the start of each period.
f. The statistics shall be available for printout and display after each period and on demand during the period.
g. In case more than one technology of AMI (example PLC and RF between Smart Meter & DCU) deployed in the field. It shall maintain statistics on the performance and availability of data being delivered per AMI technology.

7.2.4   System Protection & Security

Identity and access management system should be installed to control and log the access control for all users. The access management system shall be role based. Independent security management system shall be established to protect system and network from unauthorized access, manage user access, authorizing rights and privileges.

As the computer system in control centre has access to external environment the Contractor shall document and implement Cyber Security Policy/Plan in association with the PFCCL/ HPSEB to secure the system. The overall policy and implementation shall account for:

a. Network partition and DMZ through use of firewall as required to maximize the security of AMI application system while facilitating access for data and information to all stake holders.
b. Implement trusted, un-trusted and DMZ with clear perimeter to safeguard the HES/MDM production environment and minimise direct hits from external domain access
c. Prevent unauthorized users from reading or writing data or files, executing programs or performing operations without appropriate privileges.
d. Document all user sign on procedure
e. Record all network traffic for detecting unauthorized activity, unusual activity and attempts to defeat system security (Contractor to propose and document what constitutes normal activity/traffic)
f. A user authentication scheme consisting of at least a user identification and password shall be required for the user to request a connection to any network node.
g. GUI to provide role-based access based on user identity and user role. Shall have following types of users:
    i.   Administrator
    ii.   Operator
    iii. Field staff
    iv.   Viewer/Guest

7.3   Database

7.3.1   Initial Database Generation

The Contractor shall be responsible for the initial database generation using data available at control centre in association with the employer.

7.3.2   Development Tools

The Contractor shall provide all necessary software tools for the development and maintenance of the databases required for AMI application at Control Centre.

This tool shall be capable of managing the entire system database. The database development software tool delivered with the system shall be used to generate, integrate and test the database. The system must support export of data into XML format.

The database development tool shall facilitate exchange of both incremental and full data in standard exchange format. The product should have facility to export and import databases from different vendors applications.

7.3.3 Management

The database manager shall locate order, retrieve, update, insert, and delete data; ensure database integrity; and provide backup and recovery of database files. The database manager shall generate and modify all AMI application data by interfacing with all database structures. In systems with a distributed database, the database manager shall have access to all portions of the database wherever stored. The location of database items shall be transparent to the user performing database maintenance.

Execution of the database manager in any server of the system shall not interfere with the on-line functions of AMI applications including the normal updating of each server's real-time database. In a primary server, database editing shall be limited to viewing functions, database documentation functions and functions that change the contents but not the structure of the database. Editing the on-line database shall not affect the operation of the primary/backup configuration.

The database manager shall include the mechanisms, in both interactive and batch processing modes, to perform the following functions:
a. Add, modify and delete database items and data sources such as data links, and local I/O.
b. Add, modify and delete application program data
c. Create a new database attribute or new database object
d. Resize the entire database or a subset of the database
e. Redefine the structure of any portion of the database.

The contractor shall require to provide whether they require or impose any particular hardware and database management techniques to achieve above functionality.

7.3.4 Tracking Changes

The database manager utility shall maintain Audit trail files for all changes made by all users (both online/off-line). The audit trails shall identify each change including date and time stamp for each change and identify the user making the change. An audit trail of last 10,000 edit operations shall be maintained.

7.3.5 Integration

The System should support exchange of data from utility's computerized billing & collection, consumer indexing and asset mapping systems residing at different servers.

7.4 Display Generation, Management and Integration (Display Management and Reporting)

The Contractor shall provide necessary software tools preferably browser based for the generation, management and Integration of AMI application displays.

Displays shall be generated and edited interactively using this display generation software delivered with the system. All displays, symbols, segments, and user interaction fields shall be maintained in libraries. The size of any library and the number of libraries shall not be constrained by software. The display generator shall support the creation, editing, and deletion of libraries, including copying of elements within a library and copying of similar elements across libraries. Execution of the display generator functions shall not interfere with the on-line AMI application functions.

Displays shall be generated in an interactive mode. The user shall be able to interactively:
a. Develop display elements
b. Link display elements to the database via symbolic point names
c. Establish display element dynamics via database linkages
d. Define linkages to other displays and programs
e. Combine elements and linkages into display layers
f. Combine display layers into single displays.

All workstation features and all user interface features defined in this specification shall be supported by the display generator software.
The display generator shall support the addition, deletion and modification of segments, including the merging of one segment with another to create a new segment.

Displays shall not be limited by the size of the viewable area of the screen.

The displays shall be constructed from the display elements library. The display definition shall allow displays to be sized to meet the requirements of the AMI application for which they are used. The display generation software shall allow unbroken viewing of the display image being built as the user extends the size of the display beyond the screen size limits.

The display generator shall support the integration of new and edited displays into the active display library. During an edit session, the display generation software shall allow the user to store and recall a partial display. To protect against loss of display work when a server fails, the current work shall be automatically saved every five minutes (user adjustable) to an auxiliary memory file.

The display generator shall verify that the display is complete and error-free before integrating the display into the active display library. It shall not be necessary to regenerate any display following a complete or partial system or database generation unless the database points linked to the display have been modified or deleted.

The system shall generate reports for all the modules in user-defined formats. The system will have a graphical user interface with a capability for generating customized reports, apart from the regular ones mentioned above, as per the requirement of management and operations staff. Display of statistical data shall be presented additionally in graphical formats such as bar- graph/pie diagram etc. for convenience of analysis.

7.5   Software Utilities

Contractor shall supply all software utilities used to develop and maintain these software, whether or not specifically described by this Specification. The software utilities shall operate on-line (in

background mode) without jeopardizing other application functions running concurrently. Utility software shall be accessible from workstations, processor terminals and servers.

7.5.1   Auxiliary Memory Backup Utility

Software utility, to take back-up of auxiliary memory files of server and workstation onto a user-selected archival device such as SAN, shall be installed. Backup shall be maintained for a period of 7 years. The backup utility shall allow for user selection of the files to be saved based on:
  a. Server and workstation
  b. File names (including directory and wildcard designations)
  c. File creation or modification date and time
  d. Whether or not the file was modified since the last backup.

Further a utility for taking image backup of auxiliary memory files of the Servers and workstations shall be provided. The utility shall allow restoration of the servers/workstation from this image backup without requiring any other software. An image backup of the built system of each of the Servers and workstations shall be provided on a user-selected archival device such as SAN, which shall be used to restore the system. Automatic full or incremental back up capability of selected systems at user defined intervals shall be provided. It should be possible to restore or recover any software/system at a selected time form backup.

7.5.2   On-Line Monitoring Diagnostics Utility

On-Line monitoring diagnostic programs shall be provided for verifying the availability of the backup equipment and for limited testing of devices without interfering with on-line operations of AMI application system or the failover capability of the devices.

Redundant communication line interface equipment shall be tested by periodically retrieving data over these lines & checking for the ability to communicate with the redundant channel for any errors.

Designated backup server(s) and associated auxiliary memories shall be automatically tested for proper operation to ensure they are ready if needed for a fail over contingency. Any failure to perform diagnostic functions correctly shall cause an alarm to be issued.

7.5.3   Data Exchange Utilities

Facility of data export and import between this system and external systems shall be provided through web services.

7.5.4   Other Utility Services

AMI Application management shall include the following utility services:
  a. Loading and storage of information from labelled portable media storage units as dictated by the requirements of this specification.
  b. Preparation of .pdf output for the displays/reports available in the AMI Application system. It should also be possible to export all the reports to any MS-Office format.
  c. Displays and Reports for Web server -The Contractor shall provide utilities for preparing displays and reports suitable for Web publishing. These utilities shall be used to generate, all

required displays and reports from the system displays and reports, automatically (without requiring rebuilding).

d. On line access to user and system manuals for all software products (e.g., Operating System and Relational Database Software) and AMI applications shall be provided with computer system

e. Antivirus Software - All computers and firewalls shall be provided with the latest antivirus software as on date of supply. The antivirus software shall have the capability of having its virus definitions updated from time to time. The Contractor shall be responsible for the maintenance & update of the antivirus software during AMC period.

f. Software Upgrade-The Contractor shall be responsible for the maintenance & update of the patches and signatures of operating system, applications (AMI Applications) system and Web based System up to AMC period.

g. Automated patch management and anti-virus tools shall be provided to expedite the distributions of patches and virus definitions to the system using an orchestration facility.

These tools should consider the possibility to use standardized configurations for IT resources.

7.6 Cyber Security

The following guidelines/strategies shall be taken care of by the Contractor for making the entire Control Centre immune to Cyber Attacks.

a. All the Hardware, OS and application software shall be hardened.
b. Application, scanning and hardware scanning tools shall be provided to identify vulnerability & security threats.
c. Data shall be encrypted at system/device/technology level.
d. Network Zoning shall be implemented as per the proposed architecture. However, the Contractor may suggest other methods of network architecture without compromising the security of the System.
e. Internal user shall be allowed to access all adjacent zones. However they will not have access to remote network zone.
f. While procuring cyber security items testing must be done and the system must be secure by design.
g. Residual information risk shall be calculated by contractor and same shall be submitted to PFCCL/ HPSEB for approval.
h. All default user id & passwords shall be changed.
i. All log in/out and cable plugs in/ out shall also be logged in Central Syslog server.
j. Penetration & Vulnerability assessment test from certified auditors during FAT, SAT & AMC.
k. Auditing by third party during FAT, SAT and annually during AMC period shall be in the scope of contractor.
l. As the computer system in control centre has access to external environment the Contractor shall document and implement Cyber Security Policy/Plan in association with the PFCCL/ HPSEB to secure the system.
m. Latest Cyber Security Guidelines of CERT-In specified at http://www.cert-in.org.in / NCIIPC/ Ministry of Power or any other competent authority shall be followed.

8. Tests and Inspections

8.1   In-Process Inspection

8.1.1   Type 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 materials to this Specification. Type Testing shall comply with the following:

The contractor shall submit, within scheduled period as per project plan, copies of test reports and certificates for all of the Type Tests that are specified in the specifications and that have previously been performed. These certificates may be accepted by the PFCCL/ HPSEB only if they apply to materials and equipment that are essentially identical to those due to be delivered under the Contract and only if test procedures and parameter values are identical to those specified in this specifications carried out at nationally/Internationally accredited labs and witnessed by third party / customer's representatives .

Type Tests shall be performed for all equipment types for which certification is not provided as required above, or if it is determined by the PFCCL/ HPSEB that the certification provided is not acceptable. If any of the type tests are required to be carried out, the same shall be carried out by the contractor. The contractor shall quote testing charges for each type test individually.

Type Tests shall be certified or performed by nationally/internationally reputed laboratories using material and equipment data sheets and test procedures that have been approved by the PFCCL/ HPSEB. The test procedures shall be formatted as in the specifications and shall include a complete list of the applicable reference standards and submitted for PFCCL/ HPSEB approval at least four (4) weeks before commencement of test(s). The contractor shall provide the PFCCL/ HPSEB at least 30 days written notice of the planned commencement of each type test.

The contractor shall provide a detailed schedule for performing all specified type tests. These tests shall be performed in the presence of a representative of the PFCCL/ HPSEB.

Testing charges for all the type tests listed in the specifications shall be indicated separately for each item (excluding expenses of Inspector/ PFCCL's/ HPSEB's representative) in the prescribed schedule of the bidding document. The total amount of these charges will be considered in the bid evaluation process.

The contractor shall ensure that all type tests can be completed within the time schedule offered in its Technical Proposal.

In case of failure during any type test, the contractor is either required to manufacture a fresh sample lot and repeat all type tests successfully or repeat that particular type tests at least three times successfully on the samples selected from the already manufactured lot at its own expenses. In case a fresh lot is manufactured for testing then the lot already manufactured shall be rejected.

Documentation for all factory, field, and availability tests that apply to PFCCL/ HPSEB system shall be provided in accordance with the requirements defined in this section of specification.

8.1.2 Quality Assurance and Quality Control Program

The contractor 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 contractor's plant, in the field, or at any sub-contractor's source shall be controlled at all points necessary to assure conformance to contractual requirements.

The Quality Plan shall be mutually discussed and approved by the PFCCL/ HPSEB after incorporating necessary corrections by the contractor as may be required.

The program shall provide for prevention and ready detection of discrepancies and for timely and positive corrective action. The contractor shall make objective evidence of quality conformance readily available to the PFCCL/ HPSEB.

Instructions and records for quality assurance shall be controlled and maintained at the system levels. The contractor shall describe its QA/QC program in the Technical Proposal, (along with samples from its QA/QC manual) and shall submit its QA/QC Manual for review and acceptance by the PFCCL/ HPSEB.

Such QA/QC program shall be outlined by the contractor and shall be finally accepted by PFCCL/ HPSEB after discussions before the award of Contract. A Quality Assurance Program of the contractor 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-contractor'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.

Neither the enforcement of QA/QC procedures nor the correction of work mandated by those procedures shall be cause for an excusable delay. An effective Quality Assurance and Quality Control organization shall be maintained by the contractor for at least the duration of this Contract.

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 organization of the contractor shall be an independent administrative and functional structure reporting via its manager to the contractor'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 to the satisfaction of PFCCL/ HPSEB when actual quality deviates from that stated in the Work Statement.

The contractor shall be required to submit all the Quality Assurance Documents as stipulated in the Quality Plan at the time of PFCCL's/ HPSEB's inspection of equipment/materials.

8.1.3 Scope of Employer for QA/QC Program

The PFCCL/ HPSEB or its duly authorized representative reserves the right to carry out Quality Audit and Quality Surveillance of the systems and procedures of the contractor's/his vendor's Quality Management and Control Activities.

The scope of the duties of the PFCCL/ HPSEB, pursuant to the Contract, will include but not be limited to the following:
   a. Review of all the contractor's drawings, engineering data etc.
   b. Witness or authorize its representative to witness tests at the manufacturer's works or at site, or at any place where work is performed under the Contract.
   c. Inspect, accept or reject any equipment, material and work under the Contract in accordance with the specifications.
   d. Issue certificate of acceptance and/or progressive payment and final payment certificate
   e. Review and suggest modification and improvement in completion schedules from time to time; and
   f. Monitor the Quality Assurance program implementation at all stages of the works.

8.1.4 Inspection Certificate

The contractor shall give the PFCCL/ HPSEB two weeks in case of domestic supplies and six weeks in case of foreign supplies written notice of any material being ready for testing. Such tests shall be to the contractor's account except for the expenses of the Inspector.

The PFCCL/ HPSEB, unless witnessing of the tests is waived, will attend such tests on the scheduled date for which PFCCL/ HPSEB has been so notified or on a mutually agreed alternative date. If PFCCL/ HPSEB fails to attend the testing on the mutually agreed date, contractor may proceed with the test which shall be deemed to have been made in the Inspector's presence and contractor shall forthwith forward to the Inspector, duly certified copies of the test results in triplicate.

The PFCCL/ HPSEB shall, within fourteen (14) days from the date of inspection as defined herein, give notice in writing to the contractor of any objection to any drawings and all or any equipment and workmanship which in its opinion is not in accordance with the Contract. The contractor shall give due consideration to such objections and shall make the modifications that may be necessary to meet said objections.

When the factory tests have been completed successfully at the contractor's or Sub-contractor's works, the PFCCL/ HPSEB shall issue a certificate to this effect within fourteen (14) days after completion of tests but if the tests are not witnessed by the PFCCL/ HPSEB, the certificate shall be issued within fourteen (14) days of receipt of the contractor's Test Certificate by the PFCCL/ HPSEB.

The completion of these tests or the issue of the certificates shall not bind the PFCCL/ HPSEB to accept the equipment should it, on further tests after erection, be found not to comply with the Contract.

In cases where the Contract provides for tests, whether at the premises or works of the contractor or of any Sub-contractor, the contractor except where otherwise specified shall provide free of charge items such as labour, materials, electricity, fuel, water stores, apparatus and instruments, as may be reasonably demanded by the PFCCL/ HPSEB or its authorized representative to carry out effectively such tests of the equipment in accordance with the Contract and shall provide facilities to the PFCCL/ HPSEB or its authorized representative to accomplish testing.

The inspection by PFCCL/ HPSEB and issue of Inspection Certificate thereon, shall in no way limit the liabilities and responsibilities of the contractor in respect of the agreed Quality Assurance Program forming a part of the Contract.

The contractor shall keep the PFCCL/ HPSEB informed in advance of the time of starting of the progress of manufacture of material in its various stages so that arrangements can be made for inspection.

Record of routine test reports shall be maintained by the contractor at its works for periodic inspection by the PFCCL's/ HPSEB's representative.

Certificates of manufacturing tests shall be maintained by the contractor and produced for verification as and when desired by the PFCCL/ HPSEB. No material shall be dispatched from its point of manufacture until it has been satisfactorily inspected and tested. Testing shall always be carried out while the inspection may be waived off by the PFCCL/ HPSEB in writing only.

However, such inspection by the PFCCL's/ HPSEB's representative(s) shall not relieve the contractor from the responsibility for furnishing material, software, and equipment to conform to the requirements of the Contract; nor invalidate any claim which the PFCCL/ HPSEB may make because of defective or unsatisfactory material, software or equipment.

8.1.5 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 to PFCCL's/ HPSEB's satisfaction, and the equipment has been approved for shipment by PFCCL/ HPSEB.

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 contractor 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 submitted (c) PFCCL/ HPSEB acknowledges in writing the successful completion of the test.

8.1.5.1 Inspection

Access to the contractor's facilities while manufacturing and testing are taking place, and to any facility where hardware/software is being produced for HPSEB shall be available to PFCCL/ HPSEB representatives. The contractor shall provide to PFCCL/ HPSEB representatives sufficient facilities, equipment, and documentation necessary to complete all inspections and to verify that the equipment is being fabricated and maintained in accordance with the Specification. Inspection rights shall apply to the contractor's facilities and to Sub contractor's facilities where equipment is being manufactured.

Inspections will be performed by PFCCL/ HPSEB, which will include visual examination of hardware, enclosure cable dressings, and equipment and cable labeling. Contractor documentation will also be examined to verify that it adequately identifies and describes all wiring, hardware and spare parts. Access to inspect the contractor's hardware quality assurance standards, procedures, and records that are applicable to the facilities shall be provided to PFCCL/ HPSEB.

PFCCL/ HPSEB representatives shall be allowed access to the contractor's facilities during system manufacturing and testing and to any facility where hardware or software is being produced.

PFCCL/ HPSEB representatives shall be allowed to inspect the contractor's hardware and software quality assurance standards, procedures, and records. Documents identified in the approved software quality assurance plan will be inspected to verify that the contractor has performed the required quality assurance activities.

The inspection rights described above shall not apply to sub vendors supplying standard computer hardware, peripheral equipment, and third-party software products. The inspection rights shall apply to sub vendors developing new software for inclusion in the AMI system and to sub-system suppliers.

8.1.5.2 Test Plans & Procedures

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

The contractor shall prepare detail testing procedure in line to specification and submit for PFCCL's/ HPSEB's approval. 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. They shall be subject to PFCCL/ HPSEB approval.

8.1.5.2.1   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 contractor and PFCCL/ HPSEB 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.

8.1.5.2.2   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 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.

8.1.5.2.3   Test Records

The complete record of all factory and field acceptance tests results shall be maintained by the contractor. The records shall be maintained in a logical form and shall contain all the relevant information. The test reports shall be signed by the testing engineer and the engineer 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 contractor's test engineer and PFCCL's/ HPSEB's representative if any.
   f. Provision for comments by PFCCL's/ HPSEB's representative
   g. Copies of any variance reports generated
   h. Copies of reports, display copies, and any other hardcopy generated as part of the test.

8.1.5.2.4   Reporting of variances

Starting from the dry run test period, a variance report shall be prepared by contractor personnel 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. All such variances shall be closed in mutually agreed manner.

However, at any stage if PFCCL/ HPSEB 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 also.

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 contractor and PFCCL/ HPSEB 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 PFCCL/ HPSEB and contractor 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 contractor 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 contractor 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.

The class shall be assigned by the contractor with PFCCL/ HPSEB approval.

Variance reports shall be available to PFCCL/ HPSEB for review and comment at all times and shall be submitted by the contractor to PFCCL/ HPSEB at the start of the availability test. The contractor 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). A variance summary shall also be submitted with the progress report.

All actions taken to correct variances shall be documented on the variance report by the contractor. Sufficient information shall be provided to enable an PFCCL/ HPSEB representative to determine the need for and extent of retesting, the need for testing interactions of the correction 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 to the satisfaction of PFCCL/ HPSEB and the contractor and PFCCL/ HPSEB representatives have acknowledged correction of the variance on the variance report.

8.1.5.3   Test Initiation

The following conditions must be satisfied before starting any test
   a. All test plans and procedures for the test shall be approved by PFCCL/ HPSEB.
   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 approved by PFCCL/ HPSEB.
   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 demonstrated to PFCCL/ HPSEB.
   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 contractor using the approved test plans and test procedures.
   i. Written certification that the dry run has been successfully completed shall be provided to PFCCL/ HPSEB at least one week prior to the start of each factory test. At PFCCL/ HPSEB option, PFCCL/ HPSEB representatives will witness and participate in the dry run of any test.

8.1.5.4   Test Completion

A test shall be deemed to be successfully completed only when:
   a. All variances have been resolved to the satisfaction of PFCCL/ HPSEB
   b. All test records have been transmitted to PFCCL/ HPSEB
   c. PFCCL/ HPSEB acknowledges, in writing, successful completion of the test.

8.1.5.5   Test Suspension

Any time PFCCL/ HPSEB representatives believe that the quantity or severity of variances warrants suspension of any or all testing, the test shall be halted, remedial work shall be performed, and the complete test shall be repeated. The repeat of the test shall be scheduled for a date and time agreed upon by both the contractor and PFCCL/ HPSEB.

8.1.5.6   Factory Acceptance Test

The factory tests shall be conducted on all the equipment and 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, labeling, documentation and completeness of the hardware

Before the start of factory testing, the contractor shall verify that all changes applicable to the equipment have been implemented. As a part of the factory tests, unstructured testing shall be

performed to allow PFCCL/ HPSEB representatives to verify proper operation of the equipment under conditions not specifically tested in the above structured performance test. The contractor's test representative shall be present and the contractor's technical staff members shall be available for consultation with PFCCL/ HPSEB personnel during unstructured test periods. All special test facilities used during the structured performance test shall be made available for PFCCL's/ HPSEB's use during unstructured testing.

Factory Test Requirements:

The database, displays and the report formats developed by the contractor shall be demonstrated and verified by PFCCL/ HPSEB before factory testing.

All Field Device, AMI functions, communication & networking systems as well as performance shall be tested and demonstrated. PFCCL/ HPSEB will participate in and witness these tests.

The contractor shall also carry out testing of the standard protocol implementation for successful integration by interfacing with existing Systems before the FAT starts. The database, displays and the report formats developed by the contractor for Central System shall be verified by PFCCL/ HPSEB before factory testing.

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

The contractor is responsible for conducting all factory tests. PFCCL/ HPSEB will witness all tests and will perform selected test procedures. Knowledgeable contractor personnel shall be present at all times to assist PFCCL/ HPSEB representatives with factory testing as needed. PFCCL/ HPSEB will not accept un-witnessed test results of any hardware or software without previous written authorization.

Each of the factory tests described below (i.e. the hardware integration test, the functional performance test, and the integrated system test, unstructured tests) shall be carried out under factory test.

8.1.6.1 Hardware Integration Test

The hardware integration test shall confirm that the computer hardware conforms to this Specification and the contractor-supplied hardware documentation. The hardware integration test shall be performed when the computer hardware has been installed in the contractor'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.

8.1.6.2 Functional Performance Test

The functional performance test shall completely verify all features of the AMI Systems hardware and software. 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 and data link interfaces with other central systems.

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

k. Demonstration of the software utilities, libraries, and development tools.

l. Verification that the computer system meets or exceeds PFCCL's/ HPSEB's performance requirements

m. Verification of the accuracy of hardware and software documentation via random tests

n. Testing of spare parts

8.1.6.3 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 contractor-supplied equipment shall operate for a continuous 100-hour period. This minimum level of activity may be augmented, at the discretion of PFCCL/ HPSEB, by other activities that represent normal day-to-day operation of the system as long as these activities are conducted in accordance with the training and 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 assure PFCCL/ HPSEB 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 uncommanded functional restart or server or device fail occurs the test shall be extended by 24 hours each time such a fail over occurs. Further the test shall not be conducted with the failed device.

8.1.6.4 Unstructured Testing

Periods of unstructured testing shall be allocated to allow PFCCL/ HPSEB representatives to verify proper operation of the systems under conditions not specifically included in the approved 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 by PFCCL/ HPSEB representatives

b. The contractor's test representative shall be present and the contractor's other technical staff members shall be available for consultation with PFCCL/ HPSEB personnel 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 made available for PFCCL's/ HPSEB's 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 PFCCL's/ HPSEB's discretion both at the end of a structured test segment and after completion of the functional performance test.

The MICC for all hardware shall be issued only after successful completion of FAT as per specification. At least 10 Field Devices for each protocol shall be connected with 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.

8.2   Field Installation and Integration Test

It is expected the deliveries to site will happen in lots of meters/DCUs etc. as per schedule of the FAT. The delivery of the production hardware for the data centre (that is servers, Work Stations, LAN/Routers, Firewall, etc.) shall happen with the delivery of the first lot of meters/DCUs. In this phase of testing, the delivered equipment per lot shall be inspected for integration with data centre hardware.

The field installation test shall provide verification that computer system is operationally equivalent to the system that successfully completed factory testing. The responsibility for the conduct of the field installation test shall rest with the contractor. PFCCL/ HPSEB will witness all tests and will perform selected test procedures. Knowledgeable contractor representatives shall be present at all times to assist PFCCL/ HPSEB representatives with the testing.

The field installation test shall consist of the functional performance test to confirm operation of basic functions such as data acquisition, user interface, and the support and PFCCL/ HPSEB functions. All hardware shall be tested by running diagnostics. The exact content of the field installation test shall be determined jointly by the contractor and PFCCL/ HPSEB.

8.3   Site Acceptance Test

After all lots of equipment has been installed, the contractor 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 contractor's recommended procedures. The field performance test shall exhibit generally all functions of the equipment and duplicate factory test. All variances must be corrected prior to the start of the field performance test. The list of final tests to be carried out in the field shall be listed in the site-testing document by the contractor

8.4   Guaranteed Performance Test

Post installation, commissioning and integration of all AMI Hardware, Software, field material in project area and completion of site acceptance test, a 3 month guaranteed performance test shall be undertaken. A designated team/ person from PFCCL/ HPSEB will review the performance of AMI

system after every 30 days against the SLAs defined in this document in section 4. Should AMI system fall short of meeting the defined SLAs, the contractor may continue the test by moving the starting time of the test forward and continuing the test until the consecutive 90 days AMI SLAs has been achieved.

8.5 Operational Acceptance

Contractor's obligations for Operational acceptance of system by PFCCL/ HPSEB shall be deemed to be met when the following milestones are achieved:

a. Successful completion of Guaranteed Performance Tests
b. Completion of training obligations as defined in this RFP
c. Handing over of all training, engineering and software license documents
d. Handing over of recommended spares for warranty period and
e. Successful completion of system availability test

As part of the operation acceptance the AMI system has to undergo a 1000-hour system availability test. 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.

8.5.1 Test Responsibilities

PFCCL/ HPSEB will be responsible for conducting 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 PFCCL/ HPSEB personnel. PFCCL/ HPSEB will operate and maintain the system according to procedures described in the approved contractor documentation. PFCCL/ HPSEB shall also 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 contractor during the availability test period. When on-site maintenance support is needed, qualified contractor personnel shall arrive at the site within maximum four (4) hours of notification and shall keep PFCCL/ HPSEB fully informed 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 contractor 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 contractor's inventory.

During the availability test period, PFCCL/ HPSEB reserves the right to modify the displays and reports. Such modifications will be described to the contractor at least 48 hours in advance of implementation to allow their impact on the availability test to be assessed, except where such changes are necessary to maintain control of the power system.

8.5.2 Downtime

Downtime occurs whenever the criteria for successful operation defined in Section 8.1.15 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.

8.5.3 Hold time

During the availability test, certain contingencies may occur that are beyond the control of either PFCCL/ HPSEB or the contractor. 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" by mutual agreement of PFCCL/ HPSEB and the contractor. 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 contractor-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 contractor is engaged in remedial action and normal functions can be restored by contractor-defined procedures whenever the failure occurs. Instead of accounting for the actual intermittent downtime, one hour of downtime shall be counted for each 120 hours of otherwise successful operation while the problem persists.

d. **Failure of PFCCL's/ HPSEB's Software**: Time during which the system is down due to failure of software written and independently produced by PFCCL/ HPSEB shall be considered hold time. If a failure in such software cannot be overcome by contractor- defined procedures, execution of the failed program will be suspended. Programs developed by PFCCL/ HPSEB personnel under contractor supervision are specifically excluded from this provision.

e. **Service Response Time:** A maximum four (4) hours of hold time will be allowed for the contractor to respond to each call for maintenance support. The time between detection of a failure and the start of diagnostic procedures shall also be considered hold time when performed by PFCCL's/ HPSEB's personnel.

f. **Corrected Design Defect**: Hold time may be declared by mutual agreement to ensure against similar future occurrences if a failure occurs due to a defect in system design for which the contractor defines and implements corrective measures. In such a case, hold time shall be allowed in increments of 120 hours to allow verification of the corrective action.

8.5.4 Test Duration and Criteria for Acceptance

After the elapse of 1000 hours of cumulative test time, the availability shall be calculated. Should availability falls short of specified percentage, the contractor 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 75 days, Or (b) the contractor may restart the test for 1000 hours, however, more than two such restarts shall not be allowed.

To establish that all failures have been satisfactorily repaired prior to the end of the availability test, no downtime, intermittent (hold time) failures, or more than one uncommanded fail over shall have occurred within 240 hours of the test's conclusion.

Criteria for successful operation

The AMI system shall be designed to meet the system availability as the SLA

The total operational time shall not include the hold time. The system shall be considered available as long as all the requirements defined under section-3 are available.

The successful completion of the availability test and completion of milestones as stated above will lead to Operational Acceptance of the system. The PFCCL/ HPSEB shall issue the acceptance certificate within 30 days of notice served by the contractor.

9. Maintenance

9.1   General

The scope of work under maintenance & support services shall include a comprehensive maintenance of all the software (including licensing and annual technical support cost) and hardware along with field devices provided by the contractor under this project. The contractor shall also provide future integration and support services for meeting the future expansion requirement envisaged under this project. The maintenance practices to be followed shall be as per ISO 20000 Standard. The essence of the maintenance and support services is to provide maintenance support for the designated hardware, software and field devices, with the goal of meeting the availability as set forth herein. The contractor is to hand hold the HPSEB's team to take over maintenance and support services after completion of contractor's FMS 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.

9.2   Contractor's Maintenance Responsibility

During the entire contract period, contractor shall make available resident Project Manager, hardware & software specialists, who shall be available upon notification by PFCCL/ HPSEB about any problem(s) that may exist. The contractor's specialists shall be required to respond to the PFCCL/ HPSEB notification in line with the provisions of Technical Specifications. The contractor shall replace or repair all defective parts and shall have prime responsibility for keeping the system operational.

9.3   Maintenance Support

Period of maintenance support shall be seven (7) years from Operational Acceptance by PFCCL/ HPSEB. The period of maintenance support shall include five years Warranty (Defect Liability) period commencing from Operational Acceptance and Seven (7) years thereafter. During the above period, commencing from Site Acceptance, support for operation of the entire system is under scope of contractor.

System availability requirements during the maintenance period shall be as per the SLA.

For all third party equipment (Hardware & Software) Contractor shall have back to back support along with supply of spare with appropriate response time from OEM/OEM Authorized representatives. Contractor shall be responsible for coordination with the OEM for all matter related to that equipment. But the Contractor shall be responsible for meeting the overall response times and availability requirements specified in the Specification.

The maintenance of the System shall be comprehensive and shall comprise of the following category of works which is further elaborated for each of the different subsystems:
   a. Preventive Maintenance Activity (performance monitoring, system backup, hardware & software maintenance and update, field & network devices firmware update, emergency response and troubleshooting etc.)

b. Integration of new devices (Meters/nodes, networking devices, NIC, integration with existing system etc.)
c. Maintaining adequate spares for maintenance.

9.4 Preventative Maintenance Activity

The preventive maintenance activities shall be performed by the Contractor 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: The Contractor shall be responsible for repair/replacement of all the hardware including consumables required for the various systems. Only replacement of printer cartridge and paper rim shall be excluded from the scope of the Contractor.
b. Configuration of the replaced hardware and software, periodic routine checking as part of a preventive maintenance program (as described in further detail in this document) which would include checking of functionality of hardware and software,
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 PFCCL/ HPSEB for addition and modification of database and user interface & consumer portal displays and Database sizing activities.
e. Take Backup of the system at regular interval
f. Restoration of the systems upon its failure and to restore the functioning of the various systems at the Control Centre.

Routine works like database works, and other such day-to-day operational activity would primarily be the responsibility of HPSEB and in case of any difficulty in this regard the same shall be referred to the contractor for support.

9.4.1 Hours of Cover

The Contractor shall provide at least one engineer each at Shimla and Dharamshala who has an experience and skill to maintain the system to the desired level of availability. The contractor's on-site support for Control Centre shall be on all days from 9:00 am to 5:30 pm local time (IST), excluding public and Utility Company holidays, throughout the contract period. At least one Engineer having expertise in relevant field shall be available on all days at Control Centre. The timings for Emergency Support would be 24 hours a day, 7 days a week throughout the year.

The support personnel so deployed shall be qualified personnel having at least one year of experience in the relevant field. The contractor shall submit the CV"s and recommendation letter from customer's for all support personnel(s) to PFCCL/ HPSEB for approval before deployment at site. PFCCL/ HPSEB can ask the Contractor to replace the personnel deployed for FMS if its performance is not found to be satisfactory.

9.4.2 Service Response Requirements

The severity levels are defined in coming sections and the requirement of response time for various severity levels is defined below:

Emergency Support for Severity 1 issues are to be provided 24 hours a day, seven days a week. The on-call support team shall include all key technical competencies so that any aspect of a system failure can be attended. Severity 1 problems shall be reported by telephone for rapid response; target response times are defined in section below for severity 1 problems, the key objective is to restore the system to an operational state as quickly as possible, including by a temporary workaround. Resolution of the defect may be completed during standard hours.

Severity 2, 3, and 4 problems shall be reported by PFCCL/ HPSEB through a call tracking system to be provided by the contractor. Resolution of problems may also be provided by an individual fix that will be installed by the contractor at no extra cost to Owner.

9.5   Monitoring

The operation and performance of the various systems under AMC shall be monitored on a fortnightly basis, the contractor shall review the following, analyse the results and submit report to Employer. The contractor shall conduct at least the following monitoring at control centre:

9.5.1   Log Monitoring

a. System logs for a selected day
b. System history log
c. Aggregate data collection
d. Field & Network Device failure
e. Events collection
f. Availability of communication link

During monitoring if any defect/ abnormality are found, the contractor shall undertake corrective maintenance for the same. All coordination for failure & poor performance of ISP/ GPRS service provider shall be the responsibility of contractor during AMC period.

9.5.2   Resource Monitoring

Resource Monitoring services comprise checking the system's major node resources, gather log data, analyze results, and advise PFCCL/ HPSEB on the appropriate actions to be taken and undertake any agreed upon actions. The NMS system shall be able to continuously collect the following information:
a. CPU loading (Peak and Average)
b. Memory utilization (Peak and Average)
c. Disk utilization (Peak and Average)
d. LAN utilization (Peak and Average)
e. Operating system resource utilization reports
f. System error log

The bidder shall submit the procedures details to meet the above along with the offer.

9.5.3   Cyber Security System Monitoring

The Contractor shall also be responsible for monitoring of the cyber security system. The logs of the system shall be analyzed for exceptions and the possible incident of intrusion/trespass shall be informed to the PFCCL/ HPSEB. The monitoring shall encompass the various cyber security devices installed at Control Centre and Substations such as firewalls, Intrusion prevention system (both network based and host based), routers etc. The Centralized Monitoring Console (CMC) shall monitor and continuously collect the above logs.

The Cyber security system shall also be subjected to Annual Security Audit from CERT-In listed auditors at the cost of the Contractor during AMC period. Contractor shall implement the recommendations/remedial actions suggested by the Auditor after audit.

9.6   Patch Management

The contractor shall also be responsible for providing updates/patches for the software products supplied under the project. All other patches of third party product like Operating System and Anti-virus shall be tested by the Contractor prior to installing in the Utility's network. Other products like Firewalls shall also be provided with secure patch management. A secure patch management and deployment system is to be established which shall be provided with single point of Internet connectivity. All the patches shall be downloaded through this single point of connection. Internet connection shall be provided by utility.

The Contractor shall provide a mechanism for patch management so that it is known that what patches have been applied, what all patches are pending but available with us and what is the recent release of patches for the various products. Any patch shall be applied only with express permission of the utility's representative.

9.7   Physical Maintenance

The contractor shall undertake physical maintenance of all equipment/modules under the scope of this contract, in accordance with this section once in 3 months. 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.

9.8   Spares inventory

The Contractor shall maintain a sufficient spares inventory at its own cost to meet the spare availability requirements of the system. The spares shall be used as and when required and no separate charges are payable except the maintenance charges.

9.9   Integration of Equipment

All future services, protocol emulations & configuration support for integration of smart meters/ nodes, routers, access points, network devices, web services, integration with other offline applications etc. shall be responsibility of contractor and shall be part of the maintenance charges.

9.10 Problem/Defect Reporting

The bidder shall submit an appropriate problem/defect reporting procedure to meet the requirement of all severity levels to get the approval of the same from PFCCL/ HPSEB. The problems will be categorized as defined in Table below.

Category	Definition
Severity 1 – Urgent	Complete system failure, severe system instability, loss or failure of any major subsystem or system component such as to cause a significant adverse impact to system availability, performance, or operational capability (as described at 11.9.1-Severity-1)
Severity 2 – Serious	Degradation of services or critical functions such as to negatively impact system operation. Failure of any redundant system component such that the normal redundancy is lost (as described at 11.9.2-Severity-2) Non-availability of Man-power at Control Centre during working hours, non-availability of spares
Severity 3 – Minor	Any other system defect, failure, or unexpected operation (as described at 11.9.3-Serverity-3)
Severity 4 – General/Technical Help	Request for information, technical configuration assistance, "how to" guidance, and enhancement requests. (As described at 11.9.4-Severity-4)

9.11 Severity Levels

The detail of the systems under different severity levels is as below:

9.11.1 Severity-1(Urgent Support)

This support is required when there is a complete system failure, severe system instability, the loss/ failure of any major sub-system / system or its components, which may significantly impact the system availability, performance, or operational capability at Control centre. Following outages/disruptions will be considered under Serverity-1:

a. Loss of data due to any problem in software /hardware.
b. Loss of data due to any problem in communication network
c. Outages of any application software.
d. Cyber Security issues.
e. Outage of both Routers and LAN Switches.
f. Loss of data exchange with other computer systems of utility.

The failure of field devices shall be considered as Severity-1 level, however a maximum time of Organization and travelling time of 4/6 working hrs. shall be provided to rectify field defects.

Upon receiving intimation, the representative of the contractor would immediately attend to the problem and restore all functionalities at the earliest.

9.11.2 Severity-2

The support services not defined under Severity-1 are included under this category. Coverage under this severity would be outages that do not immediately cause on line data loss but

subsequently could result into Severity-1 category outage, loss of an important subsystem that may affect the day-to-day works and loss of archived data.

a. Failure of Storage System, stoppage of data collections for archiving and outage of other applications not covered under severity-1 are included in this category.
b. Failure of any redundant system component affecting the critical redundancy like loss of any one Application Processor, Router.
c. Non-availability of designated contractor's Man-power at control centre as well as required inventory of spares specified here.
d. Failure of one UPS system, Failure of Battery System and failure of any other system of Auxiliary
e. Power supply not covered under Severity-1 are included in this category.

9.11.3 Severity-3 (Standard Support)

The support services included under this category are when the outage or loss of functionality is neither of an emergency nor priority functionalities as indicated in severity level 1 or 2 above. Problems like database reworking, failure of any one workstation, printers etc. would be covered under this category.

9.11.4 Severity-4 (General Technical Help)

Request for information, technical configuration assistance, "how to" guidance, and enhancement requests are included under this category.

9.12 Response & Resolution Time

This section describes the target times within which the contractor should respond to support requests for each category of severity. The initial response time is defined as the period from the initial receipt of the support request (through approved communications channels) and the acknowledgment of the contractor subject to the maximum time defined in Table below. The Action Resolution Time is the period from the acknowledgement of support request to the contractor delivering a solution subject to the Maximum time defined in Table below. This period includes investigation time and consideration of alternative courses of action to remedy the situation. The Action is defined as a direct solution or a workaround.

Except for Severity Level 1 all response/resolution times (hours and days) specified below are working hours only.

Severity	Initial Response Time (Working Hours)	Initial Response Time (Non-Working Hours)	Action Resolution Time	Action
1	5 minutes	30 minutes	2 hours	An urgent or emergency situation requiring continuous attention from necessary support staff until system operation is restored – may be by workaround.
2	5 minutes	2 Hours	24 Hours	Attempt to find a solution

Severity	Initial Response Time (Working Hours)	Initial Response Time (Non-Working Hours)	Action Resolution Time	Action
				acceptable to PFCCL/ HPSEB (dependent on reproducibility), as quickly as practical.
3	2 hours	1 day	2 days	Evaluation and action plan. Resolution time is dependent on reproducibility, ability to gather data, and PFCCL's/ HPSEB's prioritization. Resolution may be by workaround.
4	2 hours	1 day	2 days	Report on the problem/query is to be furnished.

9.13   Availability and FMS Charges

The contractor shall provide guaranteed availability for various types of Systems as specified in Table below. Availability calculation methodology for Control centre hardware / software and data availability of field devices at control centre shall be as below:

9.13.1 Availability of System

The non-availability hours for availability calculation shall be counted from the end of the allowed Action Resolution time. A standardized preferably web based online ticket register shall be maintained at site containing full details of each outages, actions taken by HPSEB to correct the problem, applicable Severity level, time of reporting to the contractor support engineer/support, allowed Response time as per the Response times defined in above section, actual Resolution time, and review of Engineer-in-charge as well as the contractor's support engineer of the site.

In the event of multiple failures at a site, due to a common cause, the first FPR (Field Problem, Report) logged shall be used for the purpose of availability calculation. However, simultaneous multiple outages due to unrelated cause would be counted separately.

Availability computation shall be done on per quarter yearly basis per site. The formula to be used for availability computation shall be as under:

Availability per quarter (per site) = $\dfrac{\text{THQ- (S1 x 1+S2 x0.8+S3 x 0.5)}}{\text{THQ}} \times 100\%$

a. Where THQ is total hours in the quarter
b. S1 is the total non-available hours in Severity Level-1
c. S2 is the total non-available hours in Severity Level-2
d. S3 is the total non-available hours in Severity Level -3

9.13.2 Payment of FMS Charges

In the event of availability below a certain level, the FMS charges would be proportionately reduced as follows:

Availability of AMI System per Month	% Deduction
> 99%	NIL
Less than 99%	Penalty will be 1% of the FMS Charges per month for every 1% or part there of decrease in availability under 99%). Penalty will be calculated separately for Hardware and Software Availability. The maximum deduction shall be limited to FMS charges paid for that particular period.

The computation of Availability / Non-availability would be rounded up to 2 decimal on quarterly basis and any deduction in the FMS charges thereof would be calculated on pro-rata basis.

For Data Performance:
The following data read performance should be met by the contractor during the FMS period. If the desired performance requirements are not met, the FMS charges would be proportionately reduced as described below.

Data Type	Performance Requirement
1. Scheduled daily meter readings (as per IS 16444/15959)	
Daily collection of the previous day's interval energy data and total accumulated energy	From 95% of meters within 8 hours after midnight; and
	From 99.5% of meters within 24 hours after midnight. Average availability for the month will be computed
Penalty will be 1% of the FMS Charges per month for every 1% or part there of decrease in availability under 99.5%). Penalty will be calculated separately for Hardware and Software Availability. The maximum deduction shall be limited to FMS charges paid for that particular period.	

9.14   Contractor's Obligations and Responsibility

The contractor shall guarantee continuous availability of the system as indicated in section 9.12. In order to optimize and improve the response of the system, the contractor may re- install the program modules after making the PFCCL/ HPSEB engineer aware of the consequence (like data loss, database rebuild etc.).

Any modification of software/operating system required to restore functionality due to hardware upgrades/replacement, patches, or arising out of a necessity to fix FPRs (Field problem reports), would be done by the contractor at no extra cost to Employer.

The contractor will submit FSR (Field Service Report) and the steps taken to solve the problem, along with details of code changes.

Assistance in periodic bill generation as per requirement of Utility.

9.15 Responsibilities of PFCCL/ HPSEB

The responsibilities of the PFCCL/ HPSEB during the maintenance period are as follows:

a) HPSEB shall ensure that proper environmental conditions are maintained for the system.
b) HPSEB shall ensure that the system is kept and operated in a proper and prudent manner as described in the system documentation provided by the Contractor and only trained HPSEB representatives (or persons under their supervision) are allowed to operate the system.
c) HPSEB shall provide access to the sites of installation for purposes of providing Support Services.
d) HPSEB shall provide the contractor with Space for storage for spares.

9.16 Responsibility Matrix

The table in this section provides a summary definition of the roles and responsibilities of the contractor and PFCCL/ HPSEB.

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

Item	Task	PFCCL/ HPSEB	Contractor
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.	----	•
2.0	SOFTWARE PROBLEM RESOLUTION		
2.1	Report problem and assist with problem identification	----	•
2.2	Provide or recommend corrections, temporary patches, workarounds or other fixes to system problems	----	•
2.3	Install and test corrections, temporary patches, workarounds or other fixes to system problems	----	•
3.0	ROUTINE SOFTWARE SUPPORT		
3.1	Build and maintain database, displays and reports	F	•
3.2	Perform system back-ups	----	•
3.3	Restore or reinstall software from back-ups	----	•
3.4	Monitor system logs (part of remote monitoring service)	----	•

Item	Task	PFCCL/ HPSEB	Contractor
3.5	Maintain system logs	----	•
3.6	Maintain user accounts	•	A
4.0	HARDWARE 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	----	•
4.3	Identify failed component, Replace failed components in the system using parts from spares inventory	----	•
4.4	Restore operation of repaired/replaced equipment	----	•
5.0	HARDWARE SPARE PARTS		
5.1	Manage local spares inventory	----	•
5.2	Replenish local spares inventory	----	•
6.0	INTEGRATION AND DATABASE WORK AT CONTROL CENTRE END		
6.1	Field Device Integration	----	•
6.2	Other System Integration	----	•
7.0	CYBER SECURITY MONITORING		
7.1	Patch Updates	----	•
7.2	Cyber Security Monitoring	A	•
7.3	Annual Audits	----	•
7.4	Implementation of Recommendations during Audit	----	•
7.5	Maintenance of Spares		•
8.	Manual Meter Read through HHU in case of non-communication of Smart Meters	----	•

10. Project Management

10.1 Project Management

The Contractor shall assign a project manager with the authority to make commitments and decisions that are binding on the Contractor. PFCCL will designate a Nodal officer to coordinate all project activities. All communications between PFCCL/ HPSEB and the Contractor shall be coordinated through the project managers/ nodal officer. The project managers shall also be responsible for all communications between other members of the project staffs including sub-contractor, if any.

10.2 Project Schedule

The bidder shall submit a preliminary project implementation schedule along with the bid. The detail project implementation schedule shall be submitted by the Contractor after award for PFCCL's/ HPSEB's approval, which shall include at least the following activities:
a. Site Survey
b. Documents, Data Requirement Sheet, Drawing submission and approval
c. Type Testing Schedule
d. Hardware purchases, development/manufacturing and integration
e. Dispatch Schedule
f. Receipt, Storage, Installation & Field update schedule
g. Factory & Site Testing Schedule
h. Training schedule
i. Field trial run schedule

The project implementation schedule shall include the estimated period for completion and its linkage with other activities. The Project implementation schedule shall also contain PFCCL/ HPSEB activities as required by the Contractor to complete the project.

10.3 Progress Report

A progress report shall be prepared by the Contractor for each month against the activities listed in the project schedule. The report shall be made available to PFCCL/ HPSEB on a monthly basis, e.g., the 10th day of each month. The progress report shall include all the completed, ongoing and scheduled activities and transmittals issued and received for the month.

10.4 Transmittals

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

10.5   Review Meeting

Progress meetings shall be scheduled by the PFCCL/ HPSEB and attended by the Contractor 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.

Contractor shall also attend technical meetings as and when required by PFCCL/ HPSEB to discuss technical aspects of the project and to review PFCCL/ HPSEB comments on documents. When appropriate, these technical meetings shall be conducted as extensions to the progress meetings.

10.6   Document Review and Approval Rights

To ensure that the proposed systems conform to the specific provisions and general intent of the Specification, the Contractor shall submit documentation describing the systems to the PFCCL/ HPSEB for review and approval.

The PFCCL will respond with written comments to the Contractor within thirty (30) calendar days after receipt of the documents. Documents requiring correction must be resubmitted by the Contractor to the PFCCL within thirty (30) calendar days. PFCCL will respond to resubmitted documents within thirty (30) calendar days after receipt of the document. No implementation schedule relief is to be implied for documents requiring correction and resubmission to the PFCCL.

PFCCL/ HPSEB shall have right to require the Contractor to make any necessary documentation changes at no additional cost to the PFCCL to achieve conformance with the Specification.

Any purchasing, manufacturing, or programming implementation initiated prior to written PFCCL/ HPSEB approval of relevant documents or drawings shall be performed at Contractor risk. Review and approval by the PFCCL/ HPSEB shall not relieve the Contractor of its overall responsibilities to satisfy system functions and performance requirements in accordance with the Specification.

To help PFCCL/ HPSEB manage review and approval of documents during any given period, Contractor shall stagger 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. At any time, no more than five (5) documents shall be submitted to the PFCCL/ HPSEB for review and approval.

11. Document Requirements

11.1   General

To ensure that the proposed systems conform to the specific provisions and general intent of the Specification, the Contractor shall submit documentation to PFCCL describing the systems for review and approval. Further the Contractor shall also submit the drawings / documents for all the hardware & software required for site installation, testing and commissioning and thereafter operation of the system. The Contractor shall obtain approval of PFCCL/ HPSEB for the relevant document at each stage before proceeding for purchase, manufacturing, system deployment, factory testing, erection, site testing, training etc.

11.2   Instructions

Documents shall have unique identification No. and every revision shall be mentioned. The Contractor shall submit three (3) hard copies of each document/drawing for PFCCL's/ HPSEB's review and approval along with soft copy with each submission. After approval two (2) sets of all the documents shall be submitted as final documentation. Any changes observed during field implementation shall be incorporated in the as-built drawing and two copies of same shall be submitted to PFCCL/ HPSEB on electronic media in pdf format.

The Contractor shall also supply two (2) sets of Technical User manuals/guides/O&M manuals/manufacturers catalogues for all the hardware & software supplied under the contract. The user manual shall at minimum include the principle of operation, block diagrams, troubleshooting and diagnostic and maintenance procedures. Considering all the components of the system the following documents/drawings shall be required under the system.

11.3   Hardware Documentation Requirements

The following document shall be submitted as applicable for the subsystem.
   a. System description documents (Overview)
   b. Data requirement sheets for all items
   c. Functional description document
   d. Database documents
   e. Drawings/Documents for manufacturing/assembly of the equipment/system
   f. Drawings/Documents for installation of the equipment/system at site
   g. Installation Progress Document: Including documentation of date of installation, make and meter ID of existing replaced meter, meter ID of new meter, consumer account number, GPS coordinates, unmetered connection, existing meter status (OK, failed, meter tampering), line theft, etc. Where applicable contractor may, for recordkeeping, take photographs/ videos of installation site on approval from PFCCL/ HPSEB
   h. Software description/design documents for each module
   i. Factory test procedure and report
   j. Manuals for each equipment
   k. System configuration parameter
   l. Site testing procedure and report

m. Training documents

n. System administrator documents

o. User guide

p. Software licenses

q. Type test reports

r. Cable sizing calculations

s. Inventory of the hardware

t. General & internal arrangement drawing of panels indicating modules, components location etc.

u. Installation drawing

v. Schematic drawing

11.4   Software Documentation Requirements

The documents to be submitted shall include the following information:

11.4.1 Software Inventory

An inventory of all software shall be maintained by the Contractor. The Contractor shall submit the following inventory lists: the preliminary inventory list at the time of the Functional Description document approval, an updated inventory list immediately prior to the start of the FAT, and the final inventory list at the time of system commissioning. The inventory shall include the name of each program, a cross reference to pertinent Contractor documents, language and libraries used, and an indication of whether the program is to be standard, modified, or custom.

11.4.2 Functional Description

Functional description documentation shall be provided for each function described in this specification. It shall include the following information for each function:

a. Introduction describing the purpose of the function with references to other documentation to aid the reader's understanding of the functions performed.

b. Performance requirements that describe the execution periodicity and the tuning parameters that control or limit the capabilities of the software.

c. Complete description of the operation, data and logic interfaces with other functions.

d. Sample displays where applicable.

11.4.3 Software Design

Software design documentation shall be provided for each function before the Factory Acceptance Test. It shall include detailed descriptions of the following items:

a. The overall organization and architecture of the software logic such as a breakout of the software into software modules.

b. Mathematical algorithms and formulae.

c. Complete description of the algorithms, operation and the data and logic interfaces with other functions.

d. Data dictionary in which the following (as applicable) information for each data item in tables, file, and array is provided: (1) Name (2) Purpose, (3) Location, (4) Length of data item, and (5) Initialization.

e. Databases internal and external to the software, along with a description of all inputs required and the output produced by the software modules.

f. Interfaces with other software modules.

g. Design limitations such as field length and the maximum quantity of data items that can be processed.

11.4.4 Database Documentation

Database documentation shall describe the structure of the database. The documentation shall define the individual elements (files, records, fields, and tables) and their interrelationships. Portions of the database developed specifically for Owner's systems shall be identified.

Documentation shall also be provided that instructs the user in the preparation of data to be used for the databases, including:

a. The overall organization of input records

b. The format of each data record

c. Each data field and the valid entries pertaining to the fields.

Sufficient database documentation shall be provided to enable database to be updated or regenerated when inputs are changed & added, programs are modified, and new programs are added.

11.4.5 User Documentation

User documentation shall contain detailed operating instructions and procedures. Instructions and procedures shall be explained step-by-step with an explanation of how each step is performed, which parameters can be adjusted, and the effects obtained by varying each parameter. Additionally, the user documentation shall describe:

a. All user guidance and error messages, along with the steps necessary to recover from errors

b. The user interface including displays and keyboard operations used to control, review the input and output produced by the function. All displays relevant to the function shall be included along with a description of each dynamic display field.

c. Alarms & messages issued by the function and the conditions under which they are generated

d. Procedures to be followed for computer system restarts, failures, and failovers.

11.4.6 System Administration Documentation

System administration documentation shall be provided to guide PFCCL/ HPSEB personnel in the operation and procedures required to generate and update the systems, including system software, database, application software and other elements of the systems. System administration documents shall be provided for the following items:

a. Network communications management

b. Processor configuration

c. System performance monitoring

d. System restart/failover management and diagnostic procedures
e. System generation and management
f. Database generation and management
g. Display generation and management
h. Report generation and management
i. Diagnostic programs
j. Software utilities
k. Software maintenance
l. Application software parameters and tuning guides
m. Web administration
n. Other Contractor supplied system software not included above.

11.4.7 Test Documentation

Documentation for all factory, field and availability tests shall be provided.

11.4.8 Training Documentation

Training documentation shall be provided for all courses in accordance with the requirements.

12. Annexures

Annexure A   Whole Current A.C. Single Phase Two Wire Smart Energy Meter Of Accuracy Class 1.0 (with/ without net-metering)

A.1   General Standards Applicable for Meter

Unless otherwise specified elsewhere in this specification, the performance and testing of the meters shall conform to the following standards and amendments/revisions thereof.

S. No.	Standard No.	Title
1	IS 13779 with latest amendments	AC Static Watt-hour Meter class 1& 2
2	IS 16444 with latest amendments	A.C. Static Direct Connected Watt Hour Smart Meter Class 1 and 2- Specification
3	IS 15884 with latest amendments	Alternating Current Direct Connected Static Prepayment Meters for Active Energy (Class 1 and 2)- Specification
4	IS 15959 Part 1 & Part 2 with latest amendments	Data Exchange for Electricity Meter Reading, Tariff and Load Control- Companion Standards

A.2   Communication

Meter shall have ability to communicate with DCU/Access Point/HES on any one of the technologies mentioned in IS16444 in a secure manner, as per the site conditions and as per design requirement of the contractor. In case of GPRS/3G/4G based meter, the meter shall accommodate SIM card of any service provider. In case of Plug in type communication module, the meter shall log communication module removal /non responsive event with snapshot.

A.3   Other Specifications

Particulars	Specification
Applicable Standards	The meters shall comply with IS 16444 for all requirements. Those parameters which are not covered in IS 16444 have been specifically mentioned in this specification.
Reference Voltage	As per relevant IS
Current Rating	5-30A / 10-60A
Starting Current	As per IS 16444
Accuracy	Class 1.0 as per IS 16444
Limits of error	As per IS 16444
Operating Temperature range	As per IS 16444
Humidity	As per IS 16444

Particulars	Specification
Frequency	As per IS 16444
Influence Quantities	As per IS 16444
Power Consumption of meter	As per IS 16444
Current and Voltage Circuit	As per IS 16444
Running at No Load	As per IS 16444
Test output device	As per IS 16444
Meter Display	As per IS 16444
Name Plate & marking Meter Display	As per IS 16444
Parameters to be measured In case of net-meter both export & import parameters to be measured	As per IS 16444 / As per IS 15959 Part-2
Maximum Demand resetting	As per IS 15959 Part 2
Time of Use registers	As per IS 15959 part 2
Power Quality Information	As per IS 15959 part 2
LED/LCD Indicators	As per IS 16444
Load Survey/Interval Data	As per IS 15959 part 2
Tamper/ Event Recording	As per IS 15959 part 2
Measuring Elements	As per IS 16444
Alarm	As per IS 16444/ 15959 Part 2
Load Control	As per IS 16444
Connect/Disconnect and status of load switch	As per IS 16444
Programmability	As per IS 16444
Communication	As per IS 16444.
Communication Protocol	As per IS 16444
Remote Firmware upgrade	As per IS 15959 part 2
Real Time Clock(RTC)	As per IS 16444/ IS 15884 The clock day/date setting and synchronization shall only be possible through password/Key code command from one of the following: • From remote server through suitable communication network. • Hand Held Unit (HHU) or Meter testing work bench and this shall need password enabling for meter; The methodology for the synchronization would be as per requirement of Utility
Data Retention	As per CEA regulations
Battery Backup	Meter shall be supplied with separate battery backup for RTC.
Guarantee	Contractor shall undertake a guarantee to replace meter

Particulars	Specification
	up to a period of 60 months from the date of supply. The meter which are found defective/inoperative within the guarantee period, these defective/inoperative meters shall be replaced within one month of receipt of report for such defective/inoperative meters
First Breath(power on) and Last gasp (power off) condition detection and communication to HES	As per IS 16444
Data Display Facility (Manual/ Automatic)	Data Display shall be in three modes- • Auto Scroll • Scroll with Push Button • High Resolution (Shall display energy values with resolution of 2 digits before decimal and 3 digits after decimal in push button mode) The display order shall be: Auto Scroll • Cumulative Active Energy kWh along with legend. • Current calendar month MD in kW with legend. • Instantaneous voltage • Instantaneous current These parameters should be displayed on the LCD/LED continuously for a period of 15 seconds on Auto scroll. In case of power failure, the meter should display above parameters with push button. Scroll with Push-button • Internal diagnostics • Cumulative kWh • Date • Real Time • Voltage in (V) • Current (I) • Power (kW) • Current month MD in kW • Last month cumulative kWh • Last month MD in kW • Last month MD occurrence Date • Last month MD occurrence Time • Meter Serial Number The meter's display should return to default display mode (continues auto scroll) if push button is not operated for

Particulars	Specification
	more than 10 seconds.
Anti-Tamper Features	The meter shall continue recording energy under any tamper condition and would log the event and send alarm at Head End System after detection of the defined theft features as per IS 15959 Part 2. Optional test as per requirement of utility: The Meter shall be immune under external magnetic influences as per CBIP 325. Meter shall be tested for high voltage discharge (Spark) up to 35 KV as per CBIP 325.

Annexure B   Whole Current A.C. Three Phase Four Wire Smart Energy Meter Of Accuracy Class 1.0 (with/ without net-metering)

B.1   General Standards Applicable for Meter

Unless otherwise specified elsewhere in this specification, the performance and testing of the meters shall conform to the following standards and amendments/revisions thereof.

S. No.	Standard No.	Title
1	IS 13779 with latest amendments	AC Static Watt-hour Meter class 1& 2
2	IS 16444 with latest amendments	A.C. Static Direct Connected Watt Hour Smart Meter Class 1 and 2- Specification
3	IS 15884 with latest amendments	Alternating Current Direct Connected Static Prepayment Meters for Active Energy (Class 1 and 2)- Specification
4	IS 15959 Part 1 & Part 2 with latest amendments	Data Exchange for Electricity Meter Reading, Tariff and Load Control- Companion Standards

B.2   Communication

Meter shall have ability to communicate with DCU/Access Point/HES on any one of the technologies mentioned in IS16444 in a secure manner, as per the site conditions and as per design requirement of the contractor. In case of GPRS/3G/4G based meter, the meter shall accommodate SIM card of any service provider. In case of Plug in type communication module, the meter shall log communication module removal /non responsive event with snapshot.

B.3   Other Specifications

Particulars	Specification
Applicable Standards	The meters shall comply with IS 16444 for all requirements. Those parameters which are not covered in IS 16444 have been specifically mentioned in this specification.
Reference Voltage	As per relevant IS
Current Rating	10-60 A / 20-100 A
Starting Current	As per IS 16444
Accuracy	Class 1.0 as per IS 16444
Limits of error	As per IS 16444
Operating Temperature range	As per IS 16444
Humidity	As per IS 16444
Frequency	As per IS 16444
Influence Quantities	As per IS 16444
Power Consumption of meter	As per IS 16444

Particulars	Specification
Current and Voltage Circuit	As per IS 16444
Running at No Load	As per IS 16444
Test output device	As per IS 16444
Meter Display	As per IS 16444
Name Plate & marking Meter Display	As per IS 16444
Parameters to be measured In case of net-meter both export & import parameters to be measured	As per IS 16444 / As per IS 15959 Part-2
Maximum Demand resetting	As per IS 15959 Part 2
Time of Use registers	As per IS 15959 part 2
Power Quality Information	As per IS 15959 part 2
LED/LCD Indicators	As per IS 16444
Load Survey/Interval Data	As per IS 15959 part 2
Tamper/ Event Recording	As per IS 15959 part 2
Measuring Elements	As per IS 16444
Alarm	As per IS 16444/ 15959 Part 2
Load Control	As per IS 16444
Connect/Disconnect and status of load switch	As per IS 16444
Programmability	As per IS 16444
Communication	As per IS 16444.
Communication Protocol	As per IS 16444
Remote Firmware upgrade	As per IS 15959 part 2
Real Time Clock(RTC)	As per IS 16444/ IS 15884 The clock day/date setting and synchronization shall only be possible through password/Key code command from one of the following: • From remote server through suitable communication network. • Hand Held Unit (HHU) or Meter testing work bench and this shall need password enabling for meter; The methodology for the synchronization would be as per requirement of utility
Data Retention	As per CEA regulations
Battery Backup	Meter shall be supplied with separate battery backup for RTC.
Guarantee	Contractor shall undertake a guarantee to replace meter up to a period of 60 months from the date of supply. The meter which are found defective/inoperative within the guarantee period,

Particulars	Specification
	these defective/inoperative meters shall be replaced within one month of receipt of report for such defective/inoperative meters
First Breath(power on) and Last gasp (power off) condition detection and communication to HES	As per IS 16444
Data Display Facility (Manual/ Automatic)	Data Display shall be in three modes- • Auto Scroll • Scroll with Push Button • High Resolution (Shall display energy values with resolution of 2 digits before decimal and 3 digits after decimal in push button mode) The display order shall be: Auto Scroll • Cumulative Active Energy kWh along with legend. • Current calendar month MD in kW with legend. • Instantaneous voltage V_{RN} • Instantaneous voltage V_{YN} • Instantaneous voltage V_{BN} • Instantaneous current I_R • Instantaneous current I_Y • Instantaneous current I_B These parameters should be displayed on the LCD/LED continuously for a period of 15 seconds on Auto scroll. In case of power failure, the meter should display above parameters with push button. Scroll with Push-button • Internal diagnostics • Cumulative kWh • Date • Real Time • Voltage V_{RN} (V) • Voltage V_{YN} (V) • Voltage V_{BN} (V) • Current I_R (I) • Current I_Y (I) • Current I_B (I) • Power (kW) • Power (kVA)

Particulars	Specification
	- Current month MD in kW - Current month MD in kVAh - Last month cumulative kWh - Last month cumulative kVAh - Last month MD in kW & occurrence Date - Last month MD in kVAh & occurrence Date - Meter Serial Number The meter's display should return to default display mode (continues auto scroll) if push button is not operated for more than 10 seconds.
Anti-Tamper Features	The meter shall continue recording energy under any tamper condition and would log the event and send alarm at Head End System after detection of the defined theft features as per IS 15959 Part 2. Optional test as per requirement of utility: The Meter shall be immune under external magnetic influences as per CBIP 325. Meter shall be tested for high voltage discharge (Spark) up to 35 KV as per CBIP 325.

Annexure C   Three phase CT operated alternating current smart meter Of Accuracy Class 0.5S (with/ without net-metering)

C.1   General Standards Applicable for Meter

Unless otherwise specified elsewhere in this specification, the performance and testing of the meters shall conform to the following standards and amendments/revisions thereof.

Sl. No.	Standard No.	Title
1	IS 16444: Part 2 with latest amendments	AC Static Transformer Operated Watt-hour and VAR-Hour Smart Meters, class 0.2S, 0.5S and 1S
2	CBIP- Publication 325 with latest amendments	Standardization of AC Static Electrical Energy Meters
3	CBIP Technical report no. 111 with latest amendments	Specification for Common Meter Reading Instrument
4	IEC-62052-11 with latest amendments	Electricity metering equipment (AC) - General Requirements & test conditions Part 11. metering equipment
5	IS:9000 with latest amendments	Basic Environmental Testing Procedures for Electronic & Electrical Items.
6	ANSI/IPC-A- 610 with latest amendments	Workmanship standard for Acceptability of Electronic Assemblies (A standard developed by Institute for Interconnecting and packaging Circuits)
7	IS 12063 with latest amendments	Degrees of protection provided by enclosures of electrical equipment.
8	IS 14451, Part-2: 1999 with latest amendments	Telemetering for consumption and demand. Direct digital transfer of meter values.
9	IS 4905: 1999 with latest amendments	Methods for Random sampling.
10	IS 12346 with latest amendments	Specifications for Testing Equipment for AC Energy meter.
11	IEC-61000-4-5 with latest amendments	Electromagnetic capability, Testing and measurement techniques – Surge immunity test
12	IEC 60687 with latest amendments	AC Static Transformer Operated Watt-hour and VAR-Hour Meters, class 0.2S and 0.5S
13	IS 15959 Part 1 & Part 2 with latest amendments	Data exchange for electricity meter reading, tariff and load control: Companion specification

C.2   Communication

Meter shall have ability to communicate with DCU/Access Point/HES on any one of the technologies mentioned in IS 16444: Part 2 in a secure manner, as per the site conditions and as per design requirement of the contractor. In case of GPRS/3G/4G based meter, the

meter shall accommodate SIM card of any service provider. In case of Plug in type communication module, the meter shall log communication module removal /non responsive event with snapshot.

C.3 Other Specifications

Particulars	Specifications
Applicable Standards	The meters shall comply with IS 16444: Part2 for all requirements except for those parameters which have been specifically mentioned to be otherwise in this specification.
Reference Voltage	As per relevant IS
Current Rating	To be assessed by Contractor as per Utility requirment
Starting Current	As per IS 16444: Part2
Accuracy	Class 0.5S as per IS 16444: Part2
Limits of error	As per IS 16444: Part2
Operating Temperature range	As per IS 16444: Part2
Humidity	As per IS 16444: Part2
Frequency	As per IS 16444: Part2
Influence Quantities	As per IS 16444: Part2
Power Consumption of meter excluding communication module	As per IS 16444: Part2
Current and pressure Coil	As per IS 16444: Part2
Running at No Load	As per IS 16444: Part2
Test output device	As per IS 16444: Part2
Meter Display	Minimum 7 digit backlit white light LCD Display of minimum 10 mm height with legends to identify parameters on meter. For testing purpose, high resolution display having at least 5 decimals digits shall be provided.
Time of Use (In case of net-meter both export & import parameters to be measured)	Should support at least eight (8) Time of day tariff registers with programmable time zones and storage of billing parameters (kW, kVA, kWh & kVAh)
Parameters With net-metering)	Instantaneous parameters: As per category C1 meters according to IS 15959: Part-3: 2017

Particulars	Specifications
	Billing parameters: As per category B meters according to IS 15959: Part-3: 2017
	Load survey / Interval data parameters: As per category B meters according to IS 15959: Part-3: 2017. 35 (Power ON) days data to be recorded with 15 minutes integration period. The register shall automatically rollover the data after 35 days based on first in first out (FIFO). Instantaneous Voltage, Instantaneous Current and Instantaneous Power Factor have to read for every 15 minutes as part of Interval data. The billing parameters shall be retained in the meter for 6 months and should automatically rollover.
Power Quality Information	Logging of quality of supply events like power on/off, over/under voltage, over current (50 events) Setting of Under/ Over Voltage and Over current shall be configurable.
Maximum Demand	Should have Maximum Demand registers kW and kVA with integration period 30/15 minutes. Resets should be auto-monthly or through communication command.
Load Survey/Interval Data	35 (Power ON) days data to be recorded with 15 minutes integration period with date & time stamping for Active Energy (kWh), Apparent Energy (kVAh), Reactive Energy (kVARh), Average Voltage, Average Current, Average Power Factor and Average Demand in kW & kVA. In addition cumulative mid night kWh, kVAh, kVARh (lag/lead) (00.00 Hrs) with date & time stamp shall also be recorded for 35 (Power ON) days. The register shall automatically rollover the data after 35 days based on first in first out (FIFO). Instantaneous Voltage, Instantaneous Current and Instantaneous Power Factor have to read for every 15 minutes as part of Interval data.
LED/LCD Indicators	LED indicator for pulse/kWh. LED/LCD indicator for tamper, disconnection, current reversal (not for net-metering).
Tamper/Event recording	As per IS 15959 Part-I. 200 events shall be stored in local memory of meters.

Particulars	Specifications
Alarm	Alarm for power on/off (on restoration of power), Under Voltage, Over Voltage, Over Current, malfunctioning of diagnostic events shall be generated and communicated to the HES immediately
Measuring Elements	Meter should have four measuring elements - three in phases and one in neutral path.
Anti-Tamper features	The meter shall continue recording energy under any tamper condition and would log the event and send alarm at Head End System after detection of the defined theft features as per IS 15959 Part 2. Optional test as per requirement of utility: The Meter shall be immune under external magnetic influences as per CBIP 325. Meter shall be tested for high voltage discharge (Spark) up to 35 KV as per CBIP 325.
Programmability	It should be possible to program the parameters limits /values from remote through 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.
Communication	The port for local communication and baud rate shall be as per IS 15959. In addition to this the meter will have a provision for an Integral modular plug in type OR built in type Communication Module for NAN (Neighbourhood Area Network) i.e. from Meter to router / access points/ data collector or directly for WAN (Wide Area Network).
Communication Protocol	As per IS 15959/DLMS-COSEM
RTC & time synchronization	Meter shall have RTC with 20 years calendar programmed in the memory and provision for time synchronization, The maximum drift shall not exceed +/- 300 Seconds per year. The clock day/date setting and synchronization shall only be possible through password/Key code command from one of the following: • Hand Held Unit (HHU) or Meter testing work

Particulars	Specifications
	bench and this shall need password enabling for meter • From remote server through suitable communication network. Contractor shall submit the methodology for the synchronization of RTC.
Data Retention	Non Volatile Memory (non-battery backed up) with 10 years data retention in absence of power.
Battery Backup	Meter shall be supplied with separate battery backup for RTC and for display in case of power failure. The battery shall have a guaranteed life of 10 years from the date of installation of meters.
Data display facility (manual/Auto)	Data Display shall have following features: • High Resolution (Shall display energy values with resolution of 2 digits before decimal and 5 digits after decimal. • The Push button for manual scrolling in addition to auto scrolling with a persistence time of 10 seconds for each parameter shall be provided. Display of data as per **Annexure-H**
Guarantee	Manufacturer shall undertake a guarantee to replace meter up to a period of 5 year from the date of operation. The meter which are found defective/inoperative at the time installation or become inoperative/defective within the guarantee period, these defective/inoperative meters shall be replaced within one month of receipt of report for such defective/inoperative meters
Remote Firmware Upgrade	The meter shall support remote firmware upgrades as well remote configuration in order to remotely add new features and functions to meters without having to send person to field in secure manner.

Annexure D   Table of Compliance

The Bidder shall annotate the Table of Contents of each section and appendix of Volume – II (Technical Specifications) to provide a high-level summary of compliance status. In all cases, the following symbols, and no others shall be used:

C - Bid complies with all requirements in the adjacent paragraph.

A - Bid is not compliant with the requirements in the adjacent paragraph, but a functional alternative is proposed.

X - Bid takes exception to the requirements of the adjacent paragraph and no functional alternative is proposed.

Only one symbol shall be assigned to paragraph and shall indicate the worst case level of compliance for that paragraph. This annotation may be hand written.

The Bidder shall also underline, on the compliance copy, all requirements to which exceptions have been taken (X) or to which alternatives have been proposed (A).

Each alternative shall be clearly and explicitly described. Such descriptions shall use the same paragraph numbering as the bid document sections addressed by the alternatives. All alternative descriptions shall be in one contiguous section of the bidder's proposal, preferably in the same volume, and titled "Alternatives." A separate section titled "Exceptions" should be provided containing any discussion or explanation chooses to provide concerning exceptions taken. Alternatives which do not substantially comply with the intent of the bid documents will be considered exceptions.

Any clause which is not included in this compliance table shall be treated as "fully complied" or C

PFCCL will assess the merits of each alternative and exception and will be the sole judge as to their acceptance.

Annexure E   Bill of Quantities

Please refer Annexure 10 of this RfP

Annexure F   Data Requirement Sheet

F.1   Single Phase Whole Current Smart Meter

S. No.	Description of the Features	Minimum Requirement of Features	As per Bidder Offering
	Applicable Standards	The meters shall comply with IS 16444 for all requirements. Those parameters which are not covered in IS 16444 have been specifically mentioned in this specification.	
	Reference Voltage	As per relevant IS	
	Current Rating	5-30 A/ 10-60 A	
	Starting Current	As per IS 16444	
	Accuracy	Class 1.0 as per IS 16444	
	Limits of error	As per IS 16444	
	Operating Temperature range	As per IS 16444	
	Humidity	As per IS 16444	
	Frequency	As per IS 16444	
	Influence Quantities	As per IS 16444	
	Power Consumption of meter	As per IS 16444	
	Current and Voltage Circuit	As per IS 16444	
	Running at No Load	As per IS 16444	
	Test output device	As per IS 16444	
	Meter Display	As per IS 16444	
	Name Plate & marking Meter Display	As per IS 16444	
	Parameters to be measured (In case of net-meter both export & import parameters to be measured)	As per IS 16444 / As per IS 15959 Part-2	
	Maximum Demand resetting	As per IS 15959 Part 2	
	Time of Use registers	As per IS 15959 part 2	
	Power Quality Information	As per IS 15959 part 2	
	LED/LCD Indicators	As per IS 16444	
	Load Survey/Interval Data	As per IS 15959 part 2	
	Tamper/ Event	As per IS 15959 part 2	

S. No.	Description of the Features	Minimum Requirement of Features	As per Bidder Offering
	Recording		
	Measuring Elements	As per IS 16444	
	Alarm	As per IS 16444/ 15959 Part 2	
	Load Control	As per IS 16444	
	Connect/Disconnect and status of load switch	As per IS 16444	
	Programmability	As per IS 16444	
	Communication	As per IS 16444.	
	Communication Protocol	As per IS 16444	
	Remote Firmware upgrade	As per IS 15959 part 2	
	Real Time Clock(RTC)	As per IS 16444/ IS 15884 The clock day/date setting and synchronization shall only be possible through password/Key code command from one of the following: • From remote server through suitable communication network. • Hand Held Unit (HHU) or Meter testing work bench and this shall need password enabling for meter; The methodology for the synchronization would be as per requirement of utility	
	Data Retention	As per CEA regulations	
	Battery Backup	Meter shall be supplied with separate battery backup for RTC.	
	Guarantee	Contractor shall undertake a guarantee to replace meter up to a period of 60 months from the date of supply. The meter which are found defective/inoperative within the guarantee period, these defective/inoperative meters shall be replaced within one month of receipt of report for such defective/inoperative meters	
	First Breath(power on) and Last gasp (power off) condition detection and communication to HES	As per IS 16444	

S. No.	Description of the Features	Minimum Requirement of Features	As per Bidder Offering
	Data Display Facility (Manual/ Automatic)	Data Display shall be in three modes- • Auto Scroll • Scroll with Push Button • High Resolution (Shall display energy values with resolution of 2 digits before decimal and 3 digits after decimal in push button mode) The display order shall be: Auto Scroll • Cumulative Active Energy kWh along with legend. • Current calendar month MD in kW with legend. • Instantaneous voltage • Instantaneous current These parameters should be displayed on the LCD/LED continuously for a period of 15 seconds on Auto scroll. In case of power failure, the meter should display above parameters with push button. Scroll with Push-button • Internal diagnostics • Cumulative kWh • Date • Real Time • Voltage in (V) • Current (I) • Power (kW) • Current month MD in kW • Last month cumulative kWh • Last month MD in kW • Last month MD occurrence Date • Last month MD occurrence Time • Meter Serial Number The meter's display should return to default display mode (continues auto scroll) if push button is not operated for more than 10 seconds.	
	Anti-Tamper Features	The meter shall continue recording energy under any tamper condition and would log	

S. No.	Description of the Features	Minimum Requirement of Features	As per Bidder Offering
		the event and send alarm at Head End System after detection of the defined theft features as per IS 15959 Part 2. Optional test as per requirement of utility: The Meter shall be immune under external magnetic influences as per CBIP 325. Meter shall be tested for high voltage discharge (Spark) up to 35 KV as per CBIP 325.	

F.2 Three Phase Whole Current Smart Meter

S. No.	Description of the Features	Minimum Requirement of Features	As per Bidder Offering
	Applicable Standards	The meters shall comply with IS 16444 for all requirements. Those parameters which are not covered in IS 16444 have been specifically mentioned in this specification.	
	Reference Voltage	As per relevant IS	
	Current Rating	10-60 A /20-100 A	
	Starting Current	As per IS 16444	
	Accuracy	Class 1.0 as per IS 16444	
	Limits of error	As per IS 16444	
	Operating Temperature range	As per IS 16444	
	Humidity	As per IS 16444	
	Frequency	As per IS 16444	
	Influence Quantities	As per IS 16444	
	Power Consumption of meter	As per IS 16444	
	Current and Voltage Circuit	As per IS 16444	
	Running at No Load	As per IS 16444	
	Test output device	As per IS 16444	
	Meter Display	As per IS 16444	
	Name Plate & marking Meter Display	As per IS 16444	
	Parameters to be measured In case of net-meter both export & import parameters to be measured	As per IS 16444 / As per IS 15959 Part-2	
	Maximum Demand	As per IS 15959 Part 2	

S. No.	Description of the Features	Minimum Requirement of Features	As per Bidder Offering
	resetting		
	Time of Use registers	As per IS 15959 part 2	
	Power Quality Information	As per IS 15959 part 2	
	LED/LCD Indicators	As per IS 16444	
	Load Survey/Interval Data	As per IS 15959 part 2	
	Tamper/ Event Recording	As per IS 15959 part 2	
	Measuring Elements	As per IS 16444	
	Alarm	As per IS 16444/ 15959 Part 2	
	Load Control	As per IS 16444	
	Connect/Disconnect and status of load switch	As per IS 16444	
	Programmability	As per IS 16444	
	Communication	As per IS 16444.	
	Communication Protocol	As per IS 16444	
	Remote Firmware upgrade	As per IS 15959 part 2	
	Real Time Clock(RTC)	As per IS 16444/ IS 15884 The clock day/date setting and synchronization shall only be possible through password/Key code command from one of the following: • From remote server through suitable communication network. • Hand Held Unit (HHU) or Meter testing work bench and this shall need password enabling for meter; The methodology for the synchronization would be as per requirement of utility	
	Data Retention	As per CEA regulations	
	Battery Backup	Meter shall be supplied with separate battery backup for RTC.	
	Guarantee	Contractor shall undertake a guarantee to replace meter up to a period of 60 months from the date of supply. The meter which are	

S. No.	Description of the Features	Minimum Requirement of Features	As per Bidder Offering
		found defective/inoperative within the guarantee period, these defective/inoperative meters shall be replaced within one month of receipt of report for such defective/inoperative meters	
	First Breath(power on) and Last gasp (power off) condition detection and communication to HES	As per IS 16444	
	Data Display Facility (Manual/ Automatic)	Data Display shall be in three modes- • Auto Scroll • Scroll with Push Button • High Resolution (Shall display energy values with resolution of 2 digits before decimal and 3 digits after decimal in push button mode) The display order shall be: Auto Scroll • Cumulative Active Energy kWh along with legend. • Current calendar month MD in kW with legend. • Instantaneous voltage V_{RN} • Instantaneous voltage V_{YN} • Instantaneous voltage V_{BN} • Instantaneous current I_R • Instantaneous current I_Y • Instantaneous current I_B These parameters should be displayed on the LCD/LED continuously for a period of 15 seconds on Auto scroll. In case of power failure, the meter should display above parameters with push button. Scroll with Push-button • Internal diagnostics • Cumulative kWh • Date • Real Time	

S. No.	Description of the Features	Minimum Requirement of Features	As per Bidder Offering
		• Voltage V_{RN} (V) • Voltage V_{YN} (V) • Voltage V_{BN} (V) • Current I_R (I) • Current I_Y (I) • Current I_B (I) • Power (kW) • Power (kVA) • Current month MD in kW • Current month MD in kVAh • Last month cumulative kWh • Last month cumulative kVAh • Last month MD in kW & occurrence Date • Last month MD in kVAh & occurrence Date • Meter Serial Number The meter's display should return to default display mode (continues auto scroll) if push button is not operated for more than 10 seconds.	
	Anti-Tamper Features	The meter shall continue recording energy under any tamper condition and would log the event and send alarm at Head End System after detection of the defined theft features as per IS 15959 Part 2. Optional test as per requirement of utility: The Meter shall be immune under external magnetic influences as per CBIP 325. Meter shall be tested for high voltage discharge (Spark) up to 35 KV as per CBIP 325.	

F.3 Three Phase CT Operated Smart Meter

S. No.	Description of the Features	Minimum Requirement of Features	As per Bidder Offering
	Applicable Standards	The meters shall comply with IS 16444: Part2 for all requirements except for those parameters which have been specifically mentioned to be otherwise in this specification.	
	Reference Voltage	As per relevant IS	
	Current Rating	To be assessed by Contractor as per Utility Requirment	

S. No.	Description of the Features	Minimum Requirement of Features	As per Bidder Offering
	Starting Current	As per IS 16444: Part2	
	Accuracy	Class 0.5S as per IS 16444: Part2	
	Limits of error	As per IS 16444: Part2	
	Operating Temperature range	As per IS 16444: Part2	
	Humidity	As per IS 16444: Part2	
	Frequency	As per IS 16444: Part2	
	Influence Quantities	As per IS 16444: Part2	
	Power Consumption of meter excluding communication module	As per IS 16444: Part2	
	Current and pressure Coil	As per IS 16444: Part2	
	Running at No Load	As per IS 16444: Part2	
	Test output device	As per IS 16444: Part2	
	Meter Display	Minimum 7 digit backlit white light LCD Display of minimum 10 mm height with legends to identify parameters on meter. For testing purpose, high resolution display having at least 5 decimals digits shall be provided.	
	Time of Use (In case of net-meter both export & import parameters to be measured)	Should support at least eight (8) Time of day tariff registers with programmable time zones and storage of billing parameters (kW, kVA, kWh & kVAh)	
	Parameters With net-metering)	Instantaneous parameters: As per category C1 meters according to IS 15959: Part-3: 2017 Billing parameters: As per category B meters according to IS 15959: Part-3: 2017 Load survey / Interval data parameters: As per category B meters according to IS 15959: Part-3: 2017. 35 (Power ON) days data to be recorded with 15 minutes integration period. The register shall automatically rollover the data after 35 days based on first in first out (FIFO). Instantaneous Voltage, Instantaneous Current and Instantaneous Power Factor have to read for every 15 minutes as part of Interval data. The billing parameters shall be retained in the meter for 6 months and should automatically rollover.	
	Power Quality Information	Logging of quality of supply events like power on/off, over/under voltage, over	

S. No.	Description of the Features	Minimum Requirement of Features	As per Bidder Offering
		current (50 events) Setting of Under/Over Voltage and Over current shall be configurable.	
	Maximum Demand	Should have Maximum Demand registers kW and kVA with integration period 30/15 minutes. Resets should be auto-monthly or through communication command.	
	Load Survey/Interval Data	35 (Power ON) days data to be recorded with 15 minutes integration period with date & time stamping for Active Energy (kWh), Apparent Energy (kVAh), Reactive Energy (kVARh), Average Voltage, Average Current, Average Power Factor and Average Demand in kW & kVA. In addition cumulative mid night kWh, kVAh, kVARh (lag/lead) (00.00 Hrs) with date & time stamp shall also be recorded for 35 (Power ON) days. The register shall automatically rollover the data after 35 days based on first in first out (FIFO). Instantaneous Voltage, Instantaneous Current and Instantaneous Power Factor have to read for every 15 minutes as part of Interval data.	
	LED/LCD Indicators	LED indicator for pulse/kWh. LED/LCD indicator for tamper, disconnection, current reversal (not for net-metering).	
	Tamper/Event recording	As per IS 15959 Part-I. 200 events shall be stored in local memory of meters.	
	Alarm	Alarm for power on/off (on restoration of power), Under Voltage, Over Voltage, Over Current, malfunctioning of diagnostic events shall be generated and communicated to the HES immediately	
	Measuring Elements	Meter should have four measuring elements - three in phases and one in neutral path.	
	Anti-Tamper features	The meter shall continue recording energy under any tamper condition and would log the event and send alarm at Head End System after detection of the defined theft features as per IS 15959 Part 2. Optional test as per requirement of utility:	

S. No.	Description of the Features	Minimum Requirement of Features	As per Bidder Offering
		The Meter shall be immune under external magnetic influences as per CBIP 325. Meter shall be tested for high voltage discharge (Spark) up to 35 KV as per CBIP 325.	
	Programmability	It should be possible to program the parameters limits /values from remote through 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.	
	Communication	The port for local communication and baud rate shall be as per IS 15959. In addition to this the meter will have a provision for an Integral modular plug in type OR built in type Communication Module for NAN (Neighbourhood Area Network) i.e. from Meter to router / access points/ data collector or directly for WAN (Wide Area Network).	
	Communication Protocol	As per IS 15959/DLMS-COSEM	
	RTC & time synchronization	Meter shall have RTC with 20 years calendar programmed in the memory and provision for time synchronization, The maximum drift shall not exceed +/- 300 Seconds per year. The clock day/date setting and synchronization shall only be possible through password/Key code command from one of the following: • Hand Held Unit (HHU) or Meter testing work bench and this shall need password enabling for meter • From remote server through suitable communication network. Contractor shall submit the methodology for the synchronization of RTC.	
	Data Retention	Non Volatile Memory (non-battery backed up) with 10 years data retention in absence of power.	
	Battery Backup	Meter shall be supplied with separate battery	

S. No.	Description of the Features	Minimum Requirement of Features	As per Bidder Offering
		backup for RTC and for display in case of power failure. The battery shall have a guaranteed life of 10 years from the date of installation of meters.	
	Data display facility (manual/Auto)	Data Display shall have following features: • High Resolution (Shall display energy values with resolution of 2 digits before decimal and 5 digits after decimal. • The Push button for manual scrolling in addition to auto scrolling with a persistence time of 10 seconds for each parameter shall be provided. Display of data as per **Annexure-H**	
	Guarantee	Manufacturer shall undertake a guarantee to replace meter up to a period of 5 year from the date of operation. The meter which are found defective/inoperative at the time installation or become inoperative/defective within the guarantee period, these defective/inoperative meters shall be replaced within one month of receipt of report for such defective/inoperative meters	
	Remote Firmware Upgrade	The meter shall support remote firmware upgrades as well remote configuration in order to remotely add new features and functions to meters without having to send person to field in secure manner.	

F.4 Routers for Communication Network (If Applicable)

S. No.	Description of the Features	Minimum Requirement of Features	As per Bidder Offering
	General Requirements	• The communication network shall have dynamic & self-healing capability. If one of the communication element like router or access point fails then nodes connecting to that element shall switch to best available element for communication of data to HES. • It shall support IPv4 and IPv6 network addressing. • Each node shall keep a track of best available nearby nodes.	

S. No.	Description of the Features	Minimum Requirement of Features	As per Bidder Offering
		• The communication network equipment shall use Unlicensed or Licensed frequency band as permitted by WPC.	
		• All the communication network equipment shall be certified by WPC, Government of India for operation in license free frequency band.	
		• Suitable network management system (NMS) shall be available to monitor the performance of the communication network round the clock. The NMS shall provide viewing of all the networking elements deployed at site and enable configuration, parameterization of the networking devices and the nodes.	
		• It shall support remote firmware upgrading	
		• It shall be secure enough to avoid all cyber threats like DDoS, spoofing, malwares etc.	
		• The communication network shall ensure secure communication of data to HES.	
		• The equipment shall be weatherproof, dustproof and constructed for outdoor installation on poles (minimum rating: IP-55). A suitable mounting provision shall be made for the equipment.	
		• Enclosure: Provision for security sealing shall be provided and in case the gasket of the cover is used for protection against moisture, dust and insects, the gasket shall be made of weather and aging resistant material.	
		• The list of standards followed in all the devices/equipment used in communication network shall be furnished.	
		• Routers / Access Points shall have suitable power supply arrangements. Provision of battery backup for at least 5 hour shall be there to continue operation in case of power supply failure. The life expectancy of battery shall be 5 years or more.	

F.5 Access Points for Communication Networks (if Applicable)

S. No.	Description of the Features	Minimum Requirement of Features	As per Bidder Offering

	Configuration Requirement	• It shall be able to configure the communication with underlying nodes/end points.
		• It shall support on demand read and ping of individual/group of meters.
		• It shall push events like tamper, power off etc. to HES immediately on occurrence/receipt from field devices/meters.
		• It shall have Wide Area Network (WAN) connectivity to the HES through suitable means.
		• It shall communicate with routers/nodes/end points on RF mesh (Unlicensed or Licensed frequency band as permitted by WPC).
		• It shall periodically monitor meter reads/downstream commands and shall retry and reconnect in case of failed events/reads.
		• After power Interruption, on restoration of power supply, it shall establish communication with underlying devices as well as upstream application (HES) automatically.
		• Access point shall facilitate recording of:
		    ○ No of packet failures
		    ○ Retry attempts
		    ○ Missed periodic reading
		    ○ Failure to connect
		    ○ Tamper events
		• It shall be capable to handle interval data of suitable nos. of any type of smart meter (1ph/3ph). Access point shall be able to acquire and send data to HES for full capacity (No. of meters/field devices it is designed for) within a suitable time period to achieve the performance level. Full capacity of	

S. No.	Description of the Features	Minimum Requirement of Features	As per Bidder Offering
		access point is required to be indicated in the offer. • Access point shall support remote firmware upgrades as well as remote configuration from the control center.	

F.6 Data Concentrator Unit (DCU) (If Applicable)

S. No.	Description of the Features	Minimum Requirement of Features	As per Bidder Offering
	Configuration, Functionality & Interface	• It shall be able to configure the communication with underlying nodes/meters. • It shall pull data from the field devices and push the data at configured intervals to the HES. It should also support the HES in pulling data from the field devises/meters. The data acquisition (Push/Pull) frequency shall be programmable. DCU shall be capable to prioritize control commands. • DCU shall ensure a secure communication to HES and shall have internal memory for storing interval data for at least 5 days. • DCU shall support on demand read and ping of individual/group of meters. • It shall support IPv4 and IPv6 network addressing. • DCU shall push events like tamper, power off etc. to HES immediately on occurrence/receipt from field devices/meters. • The equipment shall be weatherproof, dustproof and constructed for outdoor installation on poles (minimum rating: IP-55). A suitable mounting provision shall be made for the equipment. • Enclosure: Provision for security sealing shall be provided and in case the gasket of the cover is used for protection against moisture, dust and insects, the gasket shall be made of weather and aging resistant material.	

S. No.	Description of the Features	Minimum Requirement of Features	As per Bidder Offering
	Communication	• The communication architecture shall be any, as defined under IS 16444. • The DCU shall ensure the appropriate backhaul for secure transfer of data to HES either via GPRS 3G/4G or Fiber Optic communication. In case of GPRS/3G/4G backhaul, it shall support SIM card with dynamic IP from any service provider. It shall have Wide Area Network (WAN) connectivity to the HES through suitable means. • DCU shall be able to communicate with meters either on RF mesh (Unlicensed or Licensed frequency band as permitted by WPC) or PLC. • DCU shall periodically monitor meter reads/downstream commands and shall retry and reconnect in case of failed events/reads. • It shall push events like tamper, power off etc. to HES immediately on occurrence/receipt from field devices/meters. DCU shall be able to acquire and send data to HES for full capacity (as per designed for no. of meters/field devices) to ensure the performance level. Full capacity of DCU is required to be indicated in the offer. • After Power Interruption, on restoration of power supply, DCU shall establish communication with underlying devices as well as upstream application automatically. • DCU shall be able to communicate with the nearest meters depending on topographical features. For further communication among the meters, distance of the other meters with the DCU shall not be a constraint as communication of the nearest meters shall be established with other meters through appropriate mesh formation / other formation. • Remote Firmware Upgrade: The DCU shall support remote firmware upgrades as well as remote configuration from the control	

S. No.	Description of the Features	Minimum Requirement of Features	As per Bidder Offering
		center. Configuration of programmable parameters of smart meters shall be done through HES. • All meters falling under one DCU shall be commissioned and checked for proper communication in presence of utility in-charge. • DCU shall keep the records of minimum of the following events: o No of packet failures o Retry attempts o Missed periodic readings o Failure to connect o Tamper events	

F.7   Requirements for Cloud Services (Refer section 3.8)

S. No.	Description of the Features	Minimum Requirement of Features	As per Bidder Offering

F.8 Workstation Consoles (Refer section 6.2. Requirements as added in section 6.2 by PFCCL shall be duplicated in the table below)

S. No.	Description of the Features	Minimum Requirement of Features	As per Bidder Offering

F.9 Monitors (Refer section 6.2. Requirements as added in section 6.2 by PFCCL shall be duplicated in the table below)

S. No.	Description of the Features	Minimum Requirement of Features	As per Bidder Offering

F.10 Firewall (Refer section 6.2. Requirements as added in section 6.2 by PFCCL shall be duplicated in the table below)

S. No.	Description of the Features	Minimum Requirement of Features	As per Bidder Offering

F.11 Router(Refer section 6.2. Requirements as added in section 6.2 by PFCCL shall be duplicated in the table below)

S. No.	Description of the Features	Minimum Requirement of Features	As per Bidder Offering

F.12 Switch (Refer section 6.2. Requirements as added in section 6.2 by PFCCL shall be duplicated in the table below)

S. No.	Description of the Features	Minimum Requirement of Features	As per Bidder Offering

F.13 Storage Area Network (SAN) (Refer section 6.2. Requirements as added in section 6.2 by PFCCL shall be duplicated in the table below)

S. No.	Description of the Features	Minimum Requirement of Features	As per Bidder Offering

F.14 Printer (Refer section 6.2. Requirements as added in section 6.2 by PFCCL shall be duplicated in the table below)

S. No.	Description of the Features	Minimum Requirement of Features	As per Bidder Offering

S. No.	Description of the Features	Minimum Requirement of Features	As per Bidder Offering

F.15 Panel Rack (Refer section 6.2. Requirements as added in section 6.2 by PFCCL shall be duplicated in the table below)

S. No.	Description of the Features	Minimum Requirement of Features	As per Bidder Offering

F.16 Local Area Network (Refer section 6.2. Requirements as added in section 6.2 by PFCCL shall be duplicated in the table below)

S. No.	Description of the Features	Minimum Requirement of Features	As per Bidder Offering

F.17 Host based Intrusion Detection System & Intrusion Prevention System (Network Based) (Refer section 6.2. Requirements as added in section 6.2 by PFCCL shall be duplicated in the table below)

S. No.	Description of the Features	Minimum Requirement of Features	As per Bidder Offering

Annexure G   System Sizing Requirement

G.1   Sizing Parameter

The system shall be designed as per the technical parameters defined in this specification and as specified in this Annexure.

The system shall be suitably sized based on data to be captured from 1,35,000 nodes with 20% expansion.

The auxiliary memory utilization of any of the Servers shall not exceed 30% of its delivered capacity at any time even under peak loading conditions like-

- 200 alarms per minutes for 5 minutes.
- 10 display request simultaneously from 5 users.
- Restoration of 100% meter data after system failure.
- System activity alarms.

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, user and geographic sites. Also, applications must evolve to support new business requirements and make use of new technologies.

G.2   Configuration requirement for Hardware & Software

S. No.	Description	No of Nodes	Future requirement
1	Head End System (HES)*	1,35,000	20% Expansion
2	Meter Data Management System (MDM)*	1,35,000	20% Expansion

*In future, HPSEB may use same HES / MDM for entire area. Provision should be there to cover such area through procurement of additional licenses.

Annexure H   Display Parameters for 3-Phase CT Operated Smart Meters

To be provided in the following sequence:

Mode : 1 (Auto Scroll)	Parameters of this mode should display on auto scrolling as well as manually up & down scrolling using push button (as mentioned in manual scrolling i.e. except repeated parameters)	
Sequence	Parameter	Notation
1	Display check	- - - - - - -
2	Sr. No. of Meters	UTP
3	CT Ratio	
4	RTC date & time	
5	R- Phase Voltage	V1
6	Y- Phase Voltage	V2
7	B- Phase Voltage	V3
8	R- Phase Line Current	I1
9	Y- Phase Line Current	I2
10	B- Phase Line Current	I3
11	Inst. Total P.F. (Avg. of 3Ph.)	Pr.PF.
12	Inst. Total active power	Pr.Kw.
13	Rising demand in KW with elapse time	
14	KW-MD of last billing period i.e. billing MD of 24hours recorded between last two resets	BMD ------------Kw
15	MD KW for Present Billing Period (After last reset)	RMD ------ Kw.
16	24hrs. apparent energy derived from Vectorial summation of total (fund+ Harm.) active energy and reactive (lag only) energy	TC Kvah
17	Cumm KWH for (Zone1)	T1C Kwh
18	Cumm. KWH for (Zone2)	T2C Kwh
19	Cumm KWH for (Zone3)	T3C Kwh
20	Cumm KWH for (Zone upto 8)	T8C Kwh
21	MD KW between last two resets – (Zone-1)	T1 BMD
22	MD KW between last two resets – (Zone-2)	T2 BMD
26	MD KW between last two resets – (Zone-3)	T3 BMD
27	MD KW between last two resets – (Zone-upto 8)	T8 BMD
28	MD KW for Present Billing – (Zone -1)	T1RMD ------ Kw

Mode : 1 (Auto Scroll)	Parameters of this mode should display on auto scrolling as well as manually up & down scrolling using push button (as mentioned in manual scrolling i.e. except repeated parameters)	
Sequence	Parameter	Notation
29	MD KW for Present Billing - (Zone -2)	T2RMD ------ Kw
30	MD KW for Present Billing – (Zone -3)	T3RMD ------ Kw
31	MD KW for Present Billing – (Zone –upto 8)	T8RMD ------ Kw
32	MD Reset Count	
33	Voltage failure count phase wise	
34	Current failure count phase wise	
35	Voltage unbalance Count	
36	Current unbalance Count	
37	Current reversal count- phase wise	
38	Magnet tamper count.	
39	Total Tamper Count	

Note :
➢ Each parameter shall be displayed for 10 seconds.
➢ The persistent tamper event indication/icon shall be displayed in auto mode.

Mode : 1 (Manual Scroll)	Parameters of this mode should display manually on up & down scrolling using push button	
Sequence	Parameter	Notation
1	Display check	- - - - - - -
2	Sr. No. of Meters	UTP
3	CT Ratio	
4	RTC date & time	
5	R- Phase Voltage	V1
6	Y- Phase Voltage	V2
7	B- Phase Voltage	V3
8	R- Phase Line Current	I1
9	Y- Phase Line Current	I2
10	B- Phase Line Current	I3
11	Inst. P.F. (Avg. of 3Ph.)	Pr.PF.
12	Inst. Total active power	Pr.Kw.

Mode : 1 (Manual Scroll)	Parameters of this mode should display manually on up & down scrolling using push button	
Sequence	Parameter	Notation
13	Rising demand in KW with elapse time	
14	24hrs. total active energy (fundamental+ harmonics)	TC Kwh
15	24hrs. total reactive energy	TC Kvarh lg
16	24hrs. apparent energy derived from Vectorial summation of total (fund+ Harm.) active energy and reactive (lag only) energy	TC Kvah
17	MD KW for Present Billing Period (After last reset)	RMD ------ Kw.
18	KW-MD of last billing period i.e. billing MD of 24hours recorded between last two resets	BMD ------------Kw
19	Cumulative MD	CMD ------------Kw
20	Cumm KWH for (Zone1)	T1C Kwh
21	Cumm. KWH for (Zone2)	T2C Kwh
22	Cumm KWH for (Zone3)	T3C K wh
26	Cumm KWH for (Zone upto 8)	T8C K wh
27	MD KW between last two resets – (Zone-1)	T1 BMD
28	MD KW between last two resets – (Zone-2)	T2 BMD
29	MD KW between last two resets – (Zone-3)	T3 BMD
30	MD KW between last two resets – (Zone-upto 8)	T8 BMD
31	MD KW for Present Billing – (Zone -1)	T1RMD ------ Kw
32	MD KW for Present Billing – (Zone -2)	T2RMD ------ Kw
33	MD KW for Present Billing – (Zone -3)	T3RMD ------ Kw
34	MD KW for Present Billing – (Zone –upto 8)	T8RMD ------ Kw
35	MD Reset Count	
36	Voltage failure count - phase wise	
37	Current failure count - phase wise	
38	Voltage unbalance Count	
39	Current unbalance Count	
40	Current reversal count- phase wise	
41	Magnet tamper count.	
42	Total Tamper Count	

Mode : 2	Parameters of this mode should display manually up & down scrolling using push button under Mode-2	
Sequence	Parameter	Notation
1	Inst. P.F.Phase 1	P.F1
2	Inst. P.F.Phase 2	P.F2
3	Inst. P.F.Phase 3	P.F3
4	Inst. Kva	Pr Kva
5	Inst. Kvar.	Pr Kvar
6	Phase Sequence - Voltage	
7	Phase Sequence -Current	
8	Frequency	Hz
S9	Cumm. KVARH (Lead)	
10	MD Kvar after last billing – (24 Hrs)	MD Kvar
11	Cumm. KVARH-lag for (Zone-1)	Kvarh1
12	Cumm KVARH-lag for (Zone-2)	Kvarh2
13	Cumm KVARH-lag for (Zone-3)	Kvarh3
14	Cumm KVARH-lag for (Zone-upto 8)	Kvarh8
15	Cumm. KVAH for (Zone-1)	Kvah1
16	Cumm KVAH for (Zone-2)	Kvah2
17	Cumm KVAH for (Zone-3)	Kvah3
18	Cumm KVAH for (Zone-upto 8)	Kvah8
19	MD KVA after last billing – (24 Hrs)	MD Kva
20	MD KVA after last billing – (Zone-1)	MD Kva1
21	MD KVA after last billing – (Zone-2)	MD Kva2
22	MD KVA after last billing – (Zone-3)	MD Kva3
23	MD KVA after last billing – (Zone- upto 8)	MD Kva8
24	MD KVA between last two resets – (Zone-1)	B Kva1
25	MD KVA between last two resets – (Zone-2)	B Kva2
26	MD KVA between last two resets – (Zone-3)	B Kva3
27	MD KVA between last two resets – (Zone- upto 8)	B Kva8
28	Fundamental Kwh	

Mode : 3	Parameters of this mode should display manually up & down scrolling using push button	
Sequence	Parameter	Notation
1	High Resolution display for Total KWH	
2	High Resolution display for KVARH-Lag	
3	High Resolution display for KVAH	
4	High Resolution display for Fundamental KWH	